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EXECUTIVE DOCUMENTS

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HOUSE OF REPRESENTATIVES

DURING THE

SECOND SESSION OF THE FORTY-FIRST CONGRESS.

1869-'70.

IN THIRTEEN VOLUMES.

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OF

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IN THE

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Letter from the Secretary of the Treasury transmitting the report of R. W. Raymond on the statistics of mines and mining west of the Rocky Mountains.

TREASURY DEPARTMENT, *March* 17, 1870.

SIR: I have the honor to transmit the report of Rossiter W. Raymond on the statistics of mines and mining in the States and Territories west of the Rocky Mountains.

Very respectfully, your obedient servant,

GEO. S. BOUTWELL,
Secretary of the Treasury.

Hon. JAMES G. BLAINE,
Speaker of the House of Representatives.

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INTRODUCTORY LETTER.

WASHINGTON, *March* 16, 1870.

SIR: I have the honor to transmit herewith my report on the statistics of mining in the States and Territories west of the Rocky Mountains, including Colorado, New Mexico, Wyoming, and Montana, which are not wholly within that category.

I estimate the bullion product for the year 1869 as follows:

California	$20,000,000
Nevada	14,000,000
Oregon and Washington	4,000,000
Idaho	7,000,000
Montana	12,000,000
Colorado and Wyoming	4,000,000
New Mexico	500,000
Arizona	1,000,000
All other sources	1,000,000
	63,500,000

The falling off, as compared with the product of 1868, is less than the severe drought, affecting the placer mines, the disastrous conflagration in three most important silver mines, and the disturbances caused by miners' strikes in various localities, would lead us to expect. In fact, the decrease in the placer product has been partly counterbalanced by an increased yield from quartz mining; and it is especially encouraging that the causes of decrease have been temporary, like a bad season in agriculture, or the accidental destruction of buildings in manufactures, while the causes of increase have been such as may be expected to operate with augmented effect hereafter. I cannot but consider the prospects of our mining industry in the precious metals as far more promising than they were a year ago. One phenomenon, which is almost universal, carries better augury for the future than any number of new and startling discoveries. I refer to the reduction of wages and other items of hitherto unreasonable expense. This relieves mining enterprises from a burden which they have in general not been able to bear, and which has been laid upon no other industry in this country in the same degree.

I beg to call particular attention to that part of the accompanying report devoted to the mining law, and to ask that it may be considered in connection with the more extended discussion of the principles underlying this subject, in my last report, which I have not felt at liberty, merely for the sake of literary or logical completeness, to repeat.

With regard to the wisdom, propriety, and necessity of a national school of mines, I see no reason to change the opinions expressed and enforced to the best of my ability in my former report. Time and more extensive observation have only confirmed me in the views there laid down, and the plan of such a school as there sketched would, I think, be the best now practicable.

The pages devoted to mineral deposits in general, mechanical appliances, and metallurgical processes, do not, of course, exhaust the subject. Their object is to give such a general view as will be of service to our own citizens, and at the same time demonstrate to the world the high excellence in many respects already attained by American miners and metallurgists. We have proved with overwhelming evidence that the mineral resources of the country are unequaled in the world. It cannot fail to strengthen our national reputation and financial credit, if we show with equal clearness that we possess the necessary skill and experience to utilize those resources, and to maintain the commercial power which is sure to arise on such a foundation.

I am deeply indebted to a large number of gentlemen, in various parts of the country, for most generous and valuable assistance in the preparation of this report. Frequently this has been rendered without any reward; where money has been paid, it has seldom exceeded the amount of expense actually incurred by the parties; and in every case I have paid less than the same service would receive from ordinary employers.

Wherever practicable I have mentioned the names of these gentlemen in connection with the information furnished by them, but in many cases I have taken such liberties with their notes and reports that it would not be just to hold the authors responsible for contributions which I have combined and altered, or estimates which I have overruled. I can, in many such cases, only give the following general acknowledgments, and say that while the credit of their generous labors should attach to these gentlemen, any hostile criticism arising by reason of the results of those labors as they appear in this report should probably be turned upon the commissioner.

I desire to express my acknowledgments in this place to the following gentlemen, besides those named in the course of the report.

California.—Mr. Walter A. Skidmore, who superintended for me the distribution of blanks, and managed the necessary correspondence in that State with great judgment and industry; Mr. J. F. Nesmith, of Grass Valley, for notes on the progress of mining in that locality; Messrs. Ashburner, Louis Janin, Hittell, Harte, and others, of San Francisco, for general assistance.

Nevada.—Messrs. J. H. Boalt, C. A. Stetefeldt, Eugene Riotte, C. C. Lane, A. A. Curtis, John Howell, and D. C. McKenney, of Austin, for much valuable information concerning Eastern Nevada, principally collected and arranged by Mr. Boalt; Messrs. C. A. Luckhardt and Alexis Janin, of Virginia City; Messrs. E. F. Dunne, C. B. Dahlgren, W. S. Keyes, George H. Willard, and others, of White Pine.

Oregon.—Messrs. S. G. Reed, J. C. Ainsworth, S. C. Mills, Mark King, of Portland; Rev. T. Condon, and Mr. A. Edgar, of Dalles City; Silas Day, Jacksonville; W. V. Rinehart, J. L. Miller, Dr. Horsley, Cañon City; E. W. Reynolds, Baker City; J. B. Griffin, Ruckel mine.

Idaho.—W. A. Atlee, P. S. Buckminster, and others, Boise City; H. Walbridge, J. M. Adams, and others, Silver City; R. Hurley, Warren's Camp.

Montana.—Mr. Augustus Steitz, of Helena, prepared the greater part of the report on this Territory, but is not wholly responsible for its present form. In addition to him, thanks are due to Messrs. Granville Stuart, S. F. Dunlap, Charles Besserer, Judge Lovell, and General Wilson, for valuable statistics of their respective counties; to Mr. George Weare, of Helena, for an excellent paper on the country east of the Bell Range; and to Messrs. Hendrie, Irwine, Town, Metcalf, Rollwitt, and many others, for courteous assistance.

Colorado.—Among many who received me with cordiality and assisted me with zeal, I would mention particularly Messrs. Byers, Thomas, and Jones, of Denver; Messrs. Clark, Bradley, and Von Schulze, of Central City; and Messrs. Cushman, Huepeden, Wolters, Brückner, Stölting, and Kurtz, of Georgetown.

New Mexico.—Mr. William Brückner, whose investigations furnished the notes for these chapters, desires acknowledgments to be made to Captain N. S. Davis, M. Bloomfield, Mr. Stürnberg, J. A. Miller, Charles Keerl, R. B. Willison, (United States mineral surveyor of New Mexico,) Dr. H. Hilgert and Dr. A. Blatchley, for assistance rendered him.

Wyoming.—Notes from this Territory, also, were collected by Mr. Brückner, who received valuable aid from Dr. H. Hahn, Mr. Erwin, A. Steck, Judge Rockwell, J. W. Anthony, J. Morin, S. Ettlinger, Charles J. Hazard, (editor of the Sweetwater Mines,) and Messrs. Taylor, Roberts and Eddy.

The part devoted to mechanical appliances of mining is the work of Professor W. P. Blake, and I believe it could not have been in better hands. Limited as to time, space, and means, Professor Blake has nevertheless succeeded in presenting a general view of the subject intrusted to him, which shows his great familiarity with the whole field, and will be, I trust, very serviceable to the country. I would acknowledge further the assistance of Dr. P. H. Van der Weyde, of New York, in the preparation of a chapter upon wind as a motor; and the very intelligent co-operation of Mr. A. Eilers, mining engineer, in the labor of editing and arranging the whole report.

During my annual journeys of 1868 and 1869, amounting in all to some 23,000 miles, and embracing portions of California, Oregon, Nevada, Idaho, Utah, Wyoming, and Colorado, I was officially the recipient of courtesies from the various transportation companies, by means of which several thousand dollars of expense were saved to the government in the preparation of these reports. Foremost among these I would name the house of Wells, Fargo & Co., which put at my disposal not only the facilities of travel, but the services, in the collection of information, of its numerous agents throughout the mining districts. Free transportation was officially furnished, also, by the Union Pacific, Central Pacific, California Pacific, Napa Valley and Oregon railroad companies, the Oregon Stage Company, Edgar's Cañon City stage line, John Hailey's overland line from Umatilla to Salt Lake, and Wilson's White Pine and Austin line.

In bringing to a close the arduous work of preparing this volume, I desire to thank the department for the enlightened sympathy with which the subjects intrusted to me have hitherto been regarded, and to express the hope that the accompanying report will be found worthy of the confidence reposed in its author.

I have the honor to be yours, respectfully,

R. W. RAYMOND,
U. S. Commissioner of Mining Statistics.

Hon. GEORGE S. BOUTWELL,
Secretary of the Treasury.

PART I.

CONDITION OF MINING INDUSTRY.

SECTION I.—CALIFORNIA.

CHAPTER I.

METHOD OF COLLECTING STATISTICS.

irous of obtaining as much information as possible with the limited priation at my disposal, and also of having this information ged according to a uniform plan, so that it might be introduced in port in a comprehensible and intelligible manner without being oluminous, I had deemed it best, after mature deliberation, to the attempt to collect certain statistics by issuing blanks. Five ent blanks were prepared: No. 1, to contain the production of gold ilver during the year; No. 2, the producing mines; No. 3, the min- aims; No. 4, the costs of mining and reducing ores; and No. 5, the running in a certain district. These blanks were sent to one or principal agents in each State or Territory, with instructions to bute the same in the following manner:

To send sets to county assessors, district assessors, and county eyors.

To the editors of newspapers in each county, with request of call- ttention to the importance of gathering statistics editorially.

To superintendents of leading mines.

To the owners or superintendents of all mills contained in the list ished in Langley's Pacific Coast Directory for 1867.

To agents of Wells, Fargo & Co. in the principal mining towns.

To prominent individuals in the various counties known to be- ested in mining.

To proprietors of smelting furnaces and "process" men.

To procure information in relation to new mills, &c., from foundries iron works, and to send blanks to owners and superintendents of mills.

To call personally on such mine owners and superintendents as- it be located in the immediate vicinity of any agent's place of res- ce.

e result has been, on the whole, a great disappointment to me as- s the use of the blanks is concerned. In fact, none were received erly filled, except from California, and even those very scattering. at State it was remarked, as a general rule, that the superintendents ined giving any information whatever, except after consultation with ers. The best and fullest returns were from owners who superin- led their own mines and mills. Many of the owners of mines residing an Francisco have not been willing to give any information what- r.

he following statement will show forcibly the indifference with which ests for information have been treated in most cases.

Statement showing number of blanks sent and answers received for California.

County.	No. of sets of blanks sent.	No. of answers received.	County.	No. of sets of blanks sent.	No. o sw recei
Alpine	10	2	Yuba	14	
Amador	33	2	Inyo and Kern	4	
Butte	8	2	Trinity and Siskiyou	4	......
Calaveras	24	2	Klamath and Del Norte	4	......
El Dorado	18	1	Mono and Los Angeles	3	......
Placer	36	6	Mariposa	....	......
Plumas	22	3	Nevada	4	
Shasta	10	2			
Sierra	22	1	Total	234	
Tuolumne	18	4			

Blank No. 1.—Only two or three of this class were returned f the quartz miners declining as a rule to give the information requ under the heads "No. of tons of ore," "average yield," "total product,' Other information required on this blank was sometimes given on bl Nos. 2 and 5.

Blank No. 2.—This blank has received more attention and has well filled, in a number of cases, except the last column—"Produ the year."

Blank No. 3.—Few of these were returned at all, probably bec there are but few "live" claims which would not come under the he "producing mines" in blank No. 2.

Blank No. 4.—This blank has been well filled from every county w ever there was a disposition shown to give any information.

Blank No. 5.—Has received prompt attention and contains a proportion of the mills running in the various districts.

The cement and placer miners have, with very few exceptions, ref to furnish any information whatever.

A striking instance of the imperfection of returns in blanks is furni by the following table, taken from the report of the surveyor ge of the State. This table does not give the number of stamps, w affords the true measure of capacity. But a simple examination is cient to show that the returns are wanting in uniformity, and somet quite absurd. The table is copied from the printed report, and the t of 1867–'8 are mostly erroneous by reason of clerical or typograp errors. As the figures stand, the totals should be: number of mills, tons crushed, 393,480; number of ditches, 874; miles in length, 11, inches of water per day, 211,896. Yet this year is in some respects b reported than the last. In the latter case clerical accuracy has blindly maintained by correctly adding the figures from the diff counties, but without any censorship. Thus we have 22 mills in P County crushing 702,760 tons of quartz, or more than one hundred daily for each mill, whereas 12 of the same mills the year before cru only 2,760 tons, or less than one ton daily per mill. At the same Nevada County, known to be the foremost quartz-mining district i State, is reported as crushing, with 73 mills, but 125,000 tons, or bet six and seven tons daily per mill. It is not probable that 50,000 were crushed in Placer County during the year, and this return s have been altered or discarded. In this case, the total of tons cru in the State would be reduced to nearly what it was the year befor

Counties.	1867—1868.					1869—1870.				
	QUARTZ MILLS.		MINING DITCHES.			QUARTZ MILLS.		MINING DITCHES.		
	Number.	Tons crushed.	Number.	Miles in length.	Amount of water used per day.	Number.	Tons crushed.	Number.	Miles in length.	Amount of water used per day.
					Inches.					*Inches.*
a	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	3	.....	.....	.....	.....	3	200	.....	.....	.....
'	31	100,000	47	418	5,718	29	69,240	35	427	5,575
	17	4,250	30	163	38,350	12	3,150	24	224	45,900
as	32	14,900	20	491	4,960	24	11,536	22	598	6,300
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Costa	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
te	.....	.....	11	24	2,850	.....	.....	.....	63	15,800
do	30	16,700	54	845	6,720	32	3,730	53	853	5,365
	2	2,210	.....	.....	.....	.....	.....	.....	.....	.....
dt	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	5	.....	1	6	40	7	.....	1	6	50
	14	25,100	6	13	2,600	9	800	4	20	1,000
a	4	3,000	62	74	14,122	3	3,000	74	60	11,055
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
geles	2	600	3	14	456	3	1,670	6	19	1,775
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
a	36	11,600	10	66	4,600	30	35,000	20	66	3,500
ino	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	3	255	1	6	300	3	.....	1	6	200
y	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	72	125,000	52	875	.....	73	125,000	53	875	.....
	12	2,760	36	379	14,900	22	702,760	36	379	12,900
	16	40,000	73	197	24,575	.....	22,600	.....	220	25,000
nto	.....	.....	.....	28½	5,000	.....	.....	2	45	4,000
uardino	2	.....	.....	.....	.....	1	.....	2	5	500
go	1	.....	.....	.....	.....	1	.....	.....	.....	.....
ncisco	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
quin	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
s Obispo	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
eo	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
arbara	.....	.....	.....	.....	.....	.....	.....	.....	.....	450
ara	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
ruz	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	5	1,785	60	296	12,426	.....	.....	.....	.....	.....
	19	20,000	32	134	12,000	19	25,000	.....	134	12,000
l	4	200	15	230	3,800	5	1,400	20	250	4,500
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
as	.....	.....	2	10	500	.....	.....	2	10	200
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	.....	1	7	160	.....	.....	.....	.....	.....
	1	.....	131	377	45,259	1	5	109	327	44,761
	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
ne	39	13,120	210	7,210	7,400	44	35,200	11	192	6,740
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	9	12,000	17	85½	5,200	9	5,500	17	63	4,400
otals	360	391,480	874	11,949¼	711,936	330	1,045,791	492	4,842	211,971

ain, the mining ditches are reported sometimes with and sometimes ut the subsidiary branches. Thus Tuolumne appears in 1867–'8 10 ditches, aggregating 7,210 miles in length and in 1869–'70 with ches, having an aggregate length of 192 miles. Yet the amount of employed, as reported, has only fallen from 7,400 to 6,740 inches These examples will show that the table, made up from the re- of district assessors, cannot bear discussion. It does not even us the data upon which to base an estimate of the relative progress artz, cement, and placer mining. In the present state of affairs, no returns thus collected can be implicitly relied upon. They may be incidentally valuable, but they must be revised and edited by experts before they can become the basis of trustworthy statistics.

Langley's Pacific Coast Directory, quoted by Mr. Ross Browne in his second report, is a specimen of a different method and reflects high credit on the industry and intelligence of its compilers. It is the result of a combination of means, including both correspondence and personal inspection. I sincerely trust its publication may be continued, as the lists of stamp mills, &c., which it has furnished have thus far been the most full and trustworthy obtained from any quarter within my knowledge.

I have accordingly employed this means only as auxiliary; and, in my reports from other States and Territories than California, have used the blanks principally as suggestive statements to my correspondents and assistants of the points concerning which information is desirable. Residents of the different districts have been appealed to, and all reports have been, as far as possible, controlled by comparison with data from other sources, including especially statistical publications of States and counties, shipments of bullion by express, population and ruling rates of wages in different districts, statements of merchants, duration of the mining season for placers, supply of water, &c. This mixed system is the best that can be adopted under the limited appropriations made for the purpose; and though the results are, in many instances, rather estimates than statistics, I believe they are sufficiently accurate to possess practical value.

CHAPTER II.

INYO COUNTY.

A great deal of activity has prevailed in this county during the year. The discovery of the richness of the veins at Cerro Gordo and vicinity has attracted much population, and over seven hundred claims have been taken up. A few of these mines had been worked before by Mexicans, but to only a small extent. During the last year, however, a great many mines have been opened, and they have yielded astonishing quantities of argentiferous lead ores. The erection of furnaces by Messrs. Belshaw and Judson, and subsequently by many others, has stimulated mining operations greatly, because the poor miners who had no other capital than their labor were thus enabled to dispose of their ores to advantage. The district is well furnished with everything necessary to carry on extensive smelting operations; wood is plenty, and the discovery of fire-clay obviates the difficulty first encountered in constructing furnaces which would resist the heat. There is a great scarcity of water in the immediate neighborhood of Cerro Gordo and the mines, but a plentiful supply of it down in the valley. Here the furnaces will probably have to be ultimately located. At present it seems that no better investment for capital could be desired than in the erection at a suitable place of large smelting works capable of separating the silver from the lead on the spot. The furnaces existing now are not well located and are likely to suffer from lack of water every summer.

The distance to Los Angeles, where the product of the furnaces has to be transported on wagon roads, is 275 miles, and freights are therefore very high; labor is also very high, as will be seen from the annexed tables, and coal has been as dear as twenty-eight cents per bushel.

Owens Valley is a fine agricultural district, and this fact will undoubtedly have a very beneficial influence on mining. The climate is mild, and no interruption of work is to be feared in the winter.

The following description of the principal mines near Cerro Gordo is from the pen of Mr. W. S. Watson, civil and mining engineer, a gentleman who has visited the region and personally inspected the mines:

The Cerro Gordo mines are located in the Inyo Mountains, a range running parallel to the Sierra, on the eastern side of Owens River Valley. They are distant from the head of Owens Lake about twelve miles, in a southeasterly direction. The district for at least ten miles on a line with the general range of the mountain, and at least two miles in width, (as far as has been prospected,) is undoubtedly rich in the various kinds of silver ores, argentiferous galena predominating. Some of the veins are extraordinarily large, reaching thirty-five feet in width, and few veins are less than eight. The prevailing "wall rock" is marble, of a grayish color, and a species of talcose slate, generally yellow brown, and very easily worked. There are about seven hundred locations within one mile square where Cerro Gordo village is, most of which have been worked for three and a half or four years, and, up to less than a year ago, principally by Mexicans, whose plan for beneficiating these ores has been by a very rude kind of "vassor," cheaply constructed, and capable only of working very rich ores.

Of the seven hundred or more locations, nearly all have been more or less developed, all showing veins of greater or less strength, from four to thirty feet, and assaying from $110 to $9,000 in silver per ton, some of the veins also showing free gold in paying quantities.

I will briefly give a description of some of the principal veins as they now show from the imperfect workings of miners who have had no capital but their own labor to use in their development. So far as I am aware, no other capital has reached this distant mining camp during the three years the district has been known to exist.

Routes, etc.—The usual routes of travel are three:

1. By the way of Los Angeles, which is the port of entry to these districts, and from which Cerro Gordo is distant two hundred and eighty-six miles, in a northeasterly direction. This route can be traveled by heavily loaded trains, all times in the year, in about sixteen days. The charges for freight are six cents per pound out, and from three to six for return freight.

2. By the Central Pacific railroad to Reno Station, thence by stage to Cerro Gordo direct, in about seven days.

3. By Gilroy, thence by stage to Havilah, in Kern County, or Kern River; thence through Walker's Pass or the Kern River trail, as the travelers may select. Either route can be traveled in six days, and if by Walker's Pass, there is a good wagon road the entire distance from Gilroy to Cerro Gordo.

As before intimated, the mines opened here show mostly carbonates, tungstate and sulphurets of lead; carbonates, gray sulphuret, and silicate of copper; and antimony—the carbonates and sulphurets of lead carrying generally from twenty-eight to fifty-five per cent. of lead, and much silver.

Freiberg.—This mine is situated high on Buena Vista Mountain, its tunnels opening on the streets of Cerro Gordo. It consists, so far as developed, of three parallel veins, cut by a tunnel five hundred feet in length. The front vein is thirty-two feet in width and twelve hundred feet long, of carbonates and sulphates of lead, carrying from $100 to $300 per ton of silver, with marble for a foot, and clay slate for hanging wall. From the level of the tunnel to the surface, a height of one hundred and nine feet, it can be worked, from which two men discharge through the winzes, sometimes, as high as sixty tons of ore per day. Vein No. 2 is nearly all sulphate of lead, with antimony, carrying about $126 per ton of silver. Its length between walls is from four to eight feet, and from the head of the tunnel to the surface one hundred and sixty feet. The length of the vein is fourteen hundred feet. Vein No. 3 is eastward, and parallel to No. 1 and No. 2, and is of a similar character to No. 1. It is fourteen hundred feet in length, and about twelve feet wide between walls. From the tunnel to the surface is about two hundred and twenty-five feet, and will yield not less than either of the two front veins.

The facility of mining the ores in these veins makes this mine a most desirable property. Little or no powder is required in extracting, and the ore is sold at the "dump" to Belshaw & Co., the owners having no reduction works of their own.

Ignacio.—This mine has been considered the best mine in the district, and worked longer than the Freiberg, and more fully opened, although in purely Mexican style. It is like the Freiberg, (and, in fact, nearly all the veins in the hill,) having a heavy deposit of what is known as galena ore, and contains carbonate and tungstate of lead, some of the ore yielding as high as $800 in silver. It is worked from the Cerro Gordo Ravine along the river by tunnels, which will command to the surface about two hundred feet in height. This property has been recently sold for $20,000, or $12 50 p foot.

San Benito.—This mine is west of the Freiberg, and east of the Ignacio. The vein about six feet wide, with clear walls of alabaster or marble and yellow clay sla The ore taken out of this vein yields from $289 to $1,490 per ton in silver. The loc debris, forming a casing between the walls and the vein, as well as the vein itself, co tain free gold in considerable quantities. None of this vein matter, except the sol ore, has been yet worked, for the want of water. The mine is worked from a sh from the highest part of the outcrop, and has been opened to seventy-five feet in dept by a shaft ten by six feet wide. It has an opening on "Cerro Gordo" ravine, and c be worked in the same manner as the Ignacio, along the vein, if thought advisable.

The San Benito is sixteen hundred feet in length. The ore that has been taken o has sold for an average of $250 per ton to the smelting works.

Queen City.—This mine is about half a mile south from "Uppertown." It is work from a tunnel of about one hundred and twenty feet, and two shafts, one in the tunn and one outside on the lead. It shows a vein of about twelve feet in width, and t height from the head of the tunnel to the highest point on the vein is about six hu dred and fifty feet, from all of which ore can be taken out through the tunnel. T ore smelts from $123 to $369 per ton in silver, and is composed of sulphuret of lea with a trace of antimony. It is what is called here a "galena" mine, and worke aside from the silver it contains, as a flux for such ores as the San Benito, St. Lou &c. There have been about forty tons of ore taken out of this mine, which sold the ground for about $150 per ton. The length of the Queen City is sixteen hundr feet. It promises to be one of the best mines in the district.

Carmel.—This mine is one thousand feet in length, near the head of Queen Ci Ravine, half a mile south from the Freiberg, at the foot of the Buena Vista Mountai It is similarly located to the Freiberg, and a tunnel run into the mountain sho a vein of twelve to fourteen feet in thickness. A contract has been made to run six feet, at which point another vein of very rich lead ore will be reached; and if the tu nel runs eight hundred feet, probably not less than ten other veins can be reache The front vein contains sulphate and carbonates of lead, carrying about $225 per t in silver. This vein is one thousand feet in length, and, from its location, can worked at the minimum cost of extracting ores.

Mexicana.—This vein is on Buena Vista Mountain, about half a mile east fro the Freiberg. It is a vein of about six feet in width and sixteen hundred feet length, and has been opened by a tunnel, showing quartz, in which are found carbona of lead, gray sulphurets and silicate of copper. It carries from $253 to $791 per ton silver.

San Cristobal.—This mine is near the Queen City, and has a tunnel, disclosing vein of about four feet in width and fourteen hundred feet in length, of pay or The ore is of the same general character as that of the Mexicana, and contains su phuret and carbonate of lead enough for smelting purposes. By smelting process tl ore has yielded about $213 per ton.

Gran Poder.—This mine is about a quarter of a mile north from the Freiberg. It opened by a tunnel, and discloses a vein of about sixteen feet in width. The mine fourteen hundred feet in length. The ore is of nearly the same character as that the Mexicana. It contains carbonate and sulphuret of lead. By smelting process has averaged three hundred dollars per ton.

St. Louis.—This mine is near the Queen City, about one mile south from the Fre berg. It has been opened from Queen City Ravine by an open cut, and shows a ve of three to six feet in width, with great facility for mining. The ore is of the san character as one vein of the Queen City—a sulphate of lead with a trace of antimoni silver, and containing about one hundred and thirty dollars per ton in silver. The l cation is one thousand feet in length, well opened, and from the level of the tunnel the outcrop on the hill shows available ore for about five hundred feet.

San Gregorio.—On the west slope of Buena Vista Mountain. It is two thousar feet in length, opened by a tunnel of twenty feet, disclosing a vein of hard or similar to the Mexicana. The vein is from four to eight feet in width, and easi worked.

The rock taken out runs from $120 to $400 per ton, by smelting process, in silver.

St. Arnold and Santenelle.—On the west slope of Buena Vista Mountain, near the Sa Gregorio, are parallel veins running north, eighteen degrees east. Both are opened l tunnels of various lengths, and disclose veins of argentiferous galena with antimon They run from eight to ten feet in width, and fourteen hundred feet in length. Tl veins are inclosed in walls, similar to the San Benito—that is, gray marble and cla slate.

Washington and Colfax.—In a parallel range to the Inyo Mountain, eighteen mil east from Cerro Gordo. They are rich in native and antimonial silver. They a generally from six to twelve feet in width of pay ore, which has been worked at tl melting furnace at Cerro Gordo with extraordinary results, ranging from $500 t

$1,500 per ton. The range is abundantly supplied with wood and water, easy of access, and only awaits the aid of capital to make the mines the most valuable in this section of the country. Some of the ores of the Washington have assayed as high as $5,680 per ton in silver.

Josephine.—Near the St. Lucas, on the northeast slope of the Buena Vista Mountain. The vein is six feet in width, of an ore similar to the Belmont, which assays $267 in silver. It is a carbonate of lead, with antimony. The vein is one thousand feet in length, and can be made to supply fifteen to twenty tons of ore per day.

Other mines.—The General Lee, twelve hundred feet; Passport, twelve hundred; St. André, one thousand; and San Miguel de la Cruz, fourteen hundred, are worthy of notice. These mines have all been opened, and show veins principally of galena, from three to fifteen feet in width. They are located on various portions of the west side of Buena Vista Hill, within half a mile of Cerro Gordo, and from them large quantities of valuable ore have, from time to time, been taken. They have not been thoroughly tested as to their individual value, but, from the appearance of the ores discovered and in sight, there is no doubt of their being as good mines as any on the Buena Vista Mountain. The Belmont, St. Lucas, and many others, lying on the east side of Buena Vista Mountain, have been developed to a considerable extent, and show rock generally carrying about nine per cent. of sulphate of lead, and exhibiting working results, by smelting, of from $250 to $800 per ton in silver. Many of these veins, with ample means for their development, will become valuable property.

Direction, dip, etc.—The general dip of the veins on the Buena Vista Mountain is southwest, at an angle of about seventy degrees with the horizon. The direction is, north sixteen to twenty degrees east.

The wall rock, in all cases, is remarkably even, both as to surface and direction; and so far as the mines that have been most extensively worked show, there can be no doubt of their being true fissure veins.

List of mining claims in Cerro Gordo mining district, Inyo County, California, on the 1st day of July, 1869, reported by W. S. Watson.

Name.	Owner.	Character.	Course.	Dip.	Dimensions of claim, in feet.	Country rock.	Vein matter.	Ore.	Value per ton.
Freiberg	John Simpson	Lode	North 20° east	82° southwest	No. 1, 1, 200 No. 2, 1, 400 No. 3, 1, 600	Talcose sl'te & gray marble.	Oxide & sulph. of lead, 32 ft.	10	$100
Ignacio	Woodworth & Co	Lode	North 16° east	81° southwest	1, 600	Talcose slate	30 feet	10	400
Queen City	L. Lasky, and others	Lodes	North 20° east	81° southwest	1, 600	Galena			
San Benito	L. Lasky, and others	Lode	North 22° east	80° southwest	1, 600	Gray marble	12 feet	4	800
Sacramento	Watson, Jones & Co	Lode	North 16° east	80° southwest	1, 200	Talcose slate	12 feet	8	1, 200
St. Tomas	Watson, Jones & Co	Lode	North 40° east	81° southwest	1, 400	Gray marble	14 feet	8	800
Carmel	Watson, Lasky & Co	Lode	North 20° east	80° southwest	1, 400	Gray marble	12 feet	6	400
Belmont	Hunter & Co	Lode	North 46° west	80° southeast	1, 000	Limestone	8 feet	3	200
Buena Vista	Heffernan & Co	Lode	North 16° east	80° southwest	1, 000	Limestone	20 feet	8	300
Washington and Colfax	W. S. Watson & Co	Lode	North and south	75° southeast	2, 200	Limestone	12 feet	12	2, 500

Remarks.—These mines are only a portion of the seven hundred locations made in this district, many of which are, no doubt, as good as the best in this list. The Freiberg is producing from twenty to sixty tons per day, and could be made to produce two hundred tons. The Ignacio is producing about fifty-five tons per day. Fifteen tons would be an average for the rest, with ten hands. There are many other "live claims," but for want of room I omit them. In fact, nearly, if not all, of the seven hundred locations may be classed "live claims," but for the want of means it is impossible to work any more than to keep up the locations as prescribed by the laws of the district. There are claims enough opened that would pay and furnish profitable employment for eight hundred to one thousand men for ten years, without sinking below the present level of the tunnels.

List of mills in Cerro Gordo mining district, Inyo County, on July 1, 1869, reported by W. S. Watson.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Horse-power of engine.	No. of stamps.	Cost of mill.	Crushing capacity per day, tons.	Amount wood consumed per day, cords.	Cost of treatment, per ton.
San Carlos, (not working)	Unknown	Independence	Steam	20	10	$25, 000	10		
Ida, (not working)	John Centro & Co	Independence		25	10				
Belshaw's Smelting Works	Belshaw & Co	Cerro Gordo	Steam	6		12, 000		4	20
Duval & Co.'s Smelting Works	Duval & Co	Cerro Gordo				4, 000		2	20
Lone Pine Smelting Works	Smith & Co	Cerro Gordo	Steam	6	1	6, 000		3	20
Swansea Smelting Works	New York Co	Swansea	Steam	12		20, 000		6	30
Union Mills, (not working)	Unknown	Bend City	Steam	20					
Cervantes Mill	Cervantes & Co	Lone Pine	Water	20	5	20, 000	5		25
Kearsarge Mill	Kearsarge Co	Kearsarge	Steam	20	10	41, 000	10	5	20
Silver Sprout Mill	Silver Sprout Co. A. D. Paul & Co.	Kearsarge	Water	20	10	30, 000	10		20

Remarks.—Mills have not been a success in this district. The ores are more adapted for smelting process, and galena being so plentiful no flux is needed.

Estimate of costs of mining and reducing ores in Cerro Gordo district, Inyo County, California, reported by W. S. Watson, July 1, 1869.

Population of district: Fifteen hundred.
Wages of first-class miners: Four dollars per day:
Wages of surface laborers: Three dollars per day.
Cost of lumber: One hundred dollars per thousand.
Cost of mining timber: Forty dollars per thousand.
Cost of common powder: Eight dollars for twenty-five pounds.
Cost of giant powder: One dollar and fifty cents per pound.
Cost of quicksilver: None used.
Cost of freight from San Francisco: One hundred and forty dollars per ton.
Cost of fuel: Six dollars per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Twenty thousand dollars.
Cost of twenty-stamp mill, freight, erection, &c.: Forty thousand dollars.
Minimum mining cost per ton of ore: One dollar.
  Mines from which this is reported: Freiberg, Queen City, Ignacio, Sacramento.
  Character of rock at those mines: Sulphurets, carbonates of lead, and argentiferous galena.
  Depth of mine: Worked from tunnels.
Maximum mining cost per ton: Five dollars.
  Mines from which this is reported: San Benito, Belmont, St. Lucas.
  Character of rock, &c.: Sulphurets, carbonates, tungstate of lead, and argentiferous galena.
  Depth of mine: worked from tunnels.
Character of process employed: Smelting.
Average mining cost, per ton: Two dollars and fifty cents.
Average smelting cost, per ton: Ten dollars.
Average pulp-assay of ore: Two hundred dollars per ton.
Average yield of ore: One hundred and fifty dollars per ton.

Remarks.—This district has been very imperfectly prospected, principally by Mexicans, until this summer, when others commenced.

List of mills in Cerro Gordo mining district, Inyo County, California, on July 1, 1869, reported by M. W. Belshaw.

Name of mill.	Owners.	Location.	Kind of power, water or st'm.	Horse-power of engine.	No. of stamps.	Weight stamp.	No. drops per minute.	Height of drop, inches.	Diameter die.	Diameter shoe.	No. and kind of pans, (copper.)	Cost of mill.	Crushing capacity per day.	Size of screen.	Cost of treatment, per ton.
									Inch.	*Inch.*			*Tons.*	*M'sh.*	
M. W. Belshaw & Co[*]	M. W. Belshaw & E. Judson	Cerro Gordo	Steam	8											$20 to $25.
Wolfskill & Cervantes Cos		Lone Pine	Water	20	5	650	60	8	7	7	1	$25,000	15	½ in.	
Swansea Mill[*]	Owens Lake Lead and Silver Co	Swansea	Steam.	12											$30 to $35, including freight.

[*] Smelting works capacity twelve tons per day.

There are three or four other small furnaces of one to two tons capacity.

Exhibit of producing mines in Cerro Gordo mining district, Inyo County, California, on July 1, 1869, reported by M. W. Belshaw.

Name.	Owner.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Ore.	Average value. (Assay.)	Product for the year ending July 1, 1869.
					Feet.					*Tons.*
Union	Sundry	Vein	North and south	80°	1,800	Slate and lime	Yellow earth	Lead and silver	$50	175
Freiberg No. 1	Sundry	Vein	North and south	80°	2,000	Slate and lime	Yellow earth	Lead and silver	30	1,200
Belmont	Sundry	Vein	North and south	80°	1,600	Slate and lime	Limestone & quartz	Copper, lead, silver, arsenic, and antimony.	250	30
San Ignacio	Sundry	Vein	North and south	80°	1,600	Slate and lime	Limestone & quartz.	Copper, lead, silver, arsenic, and antimony.	225	60
San Lucas	Sundry	Vein	North and south	80°	2,000	Slate and lime	Limestone & quartz.	Copper, lead, silver, arsenic, and antimony.	200	20

CHAPTER III.

MARIPOSA COUNTY.

The principal operations carried on in this county have been those of the Mariposa company, and the Oaks and Reese mine, both of which were mentioned in my last report. Concerning the former, numerous official reports have been published during the year, the company having adopted the praiseworthy policy of advertising its stockholders and the public of the progress of its operations more frequently than by annual reports. The mines worked have been the Josephine, Pine Tree, and Mariposa. Mr. F. Goodsell, the company's engineer, reports under date of September 1, 1869:

> The amount of dead-work done at the Mariposa mine has exposed a large quantity of ore, and there is sufficient breadth of ore-ground uncovered in the various shafts, drifts, and wings to furnish a supply for a considerable time. About four hundred tons are already mined, and with the present number of miners we can prosecute the necessary dead-work, and furnish daily all the ore the mill can pulverize. The ore now being taken out is rich, showing free coarse gold throughout. The limited number of miners engaged in the Josephine mine are making good progress, although working at many different points. Stoping in the rich shoot of ore recently opened east of the main shaft, and driving the level underneath, progresses rather slowly, owing to the great breadth of vein. Altogether, the mine is looking well, and in condition to furnish steadily a large quantity of ore. Most of the ore recently stoped in this mine is stored in the [*]west shaft for further use; the Pine Tree mine at present furnishing a large portion of the ore that is sent to the mills. This mine is looking splendidly. The large number of men now employed has greatly improved its appearance. The extension of the engine drift eastward has disclosed the well-known "Garden shoot," so rich in the upper levels. The "big stope" west of the main shaft is looking better than ever, and never since work was resumed has the mine generally been so promising. There is now open and proved over nine hundred feet horizontal length of ore-bearing ground. With the present force of miners there is being sent to the mill thirty tons of ore daily, and at the same time carrying forward a fair amount of dead-work. A few tons of ore have been sent for testing to the Benton mills, from the shaft of the "Green's Gulch" mine, where there is a large quantity of ore standing in sight. Ore from this source is not required at present, as we have, according to estimates—

	Tons.
At the Benton mills	1,800
Stored in Josephine mine	300
On surface at Mariposa mine	400
Miscellaneous	100
Aggregate	2,600

> The following may be assumed as a low estimate of the quantities to depend upon, being mostly uncovered:

	Tons.
Mariposa mine	2,500
Josephine mine	3,500
Pine Tree mine	15,000
Aggregate	21,000

> And in the known reserves:

	Tons.
Mariposa mine	6,000
Josephine mine	9,000
Pine Tree mine	15,000
Aggregate	30,000

> This estimate does not include ores that extend beyond points that have been tested by the lowest drifts and the various shafts and winzes. The value of these ores can only be determined by further working.

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[*] See diagrams of Josephine and Pine Tree in my last report.

The process of dry-crushing and amalgamation with Ryerson's apparatus, described in my last report, has been rejected, after trial upon a large scale. The machinery gave favorable results at the Little Bear Valley mill, where I saw it in operation in 1868; but it has been found in many respects unsuited to extensive operations. It was always acknowledged to be more expensive than the ordinary California process. The necessity of dry-crushing, to begin with, was a great economical disadvantage. In spite of the claims of numerous inventors, I have yet to see a dry-crushing apparatus that will accomplish as much with the same power as a good stamp-battery, crushing wet. The items of repairs, danger from fire, and noxious effects of quicksilver fumes, which could not be calculated from working results in a small mill, have been found extremely serious in larger operations, and constitute a considerable addition to the acknowledged costs of the Ryerson process. It should be pointed out that many of the drawbacks to that process are of such a character that they are not ameliorated by a decrease in the cost of labor; while, on the other hand, the ordinary stamp-mill process is, by this cause and by constant improvement in machinery, growing steadily both cheaper and more effective. Its principal deficiency, the loss of sulphurets, is not remedied by the Ryerson method; and the subsequent treatment of this material by concentration and chlorination, pan-amalgamation, or otherwise, is as easy in one case as in the other. The experience of the Oaks and Reese mine, in the immediate neighborhood of the Mariposa estate, where improved wet amalgamation is very successfully used, led to a comparative test in November last, at the Benton mills, between the wet and dry methods, the consequence of which, I am informed, was the rejection of the latter.

The production of bullion during 1869 was considerably hindered by these experiments and by the necessary dead-work, and did not, so far as I can learn, exceed $100,000. The company began the year 1870 under better auspices, and is now reported to be producing about $1,000 per day, with constructions in progress that will largely increase the capacity of the mills, which is still inadequate to the production of the mines. More exact statements will be made in the company's annual report in March, 1870.

The Oaks and Reese mine, under the skillful management of Mr. Cassell, has continued to produce bullion, at the rate as reported, of $30,000 monthly, throughout the year.

I have no reports of other important operations in the county.

CHAPTER IV.

TUOLUMNE COUNTY.

Mining has not been very flourishing in this county during the last year. The following letter from W. G. Heslep furnishes such general remarks, as will permit a clear insight into the circumstances surrounding mining in the county at present:

JAMESTOWN, *August* 25, 1869.

DEAR SIR: In filling up your blank schedules I have aimed to give a true estimate of the facts wished for in the schedules. They may not be strictly correct in every particular, but sufficiently so for all practical purposes. The mining interest in this county at present is somewhat depressed, owing to various causes; many of the owners are men without capital and are dependent entirely upon the yield of the mines to meet all demands for exploring, developing, and all working expenses. Speculation in mining property the last few years has had a depressing influence. Discoveries in other portions of the country have taken away capital and population; legitimate mining has been to some extent destroyed by unprincipled speculators, who have practiced the vilest frauds upon unsuspecting parties, selling worthless mines and expending large amounts of money without the least prospect of reimbursement. Three-fourths of the mills in the county are lying idle at present owing to various causes; in most cases, however, it is only temporary. I have no data to give me an idea of the amount of bullion produced, but my impression is that it is not over one-half of what it has been during the last two years.

Hoping that the facts given will assist you some,

I remain, yours, truly,

W. G. HESLEP.

R. W. RAYMOND, Esq.

List of mills in Tuolumne County mining district, Tuolumne County, on July 1, 1869, reported by W. G. Heslep.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Horse-power of engine.	No. of stamps.	Weight stamp.	No. of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	No. and kind of pans.	Cost of mill.	Crushing capacity per day.	Size of screen.	Height screen above die.	Amount wood consumed per day.	Cost of treatment, per ton.
								In.	*In.*	*In.*			*Tons.*		*In.*	*Cords.*	
Clio	Eastern company	Jacksonville	Water		10	500	60	8	7	7	2 pans.	$10,000	10	60	10		$7 00*
Eagle	Eastern company	Blue Gulch	Water		10	500	80	6	7	7		13,000	8 to 10	60	10		8 00*
Shawmut	Eastern company	Blue Gulch	Water								5 pans.	8,000	5				10 00*
Golden Rule	Incorporated company	Poverty Hill	Water		15	750	70	6	6	8	1 arrastra.	15,000	15	50	8		4 50
Knox & Co.	Knox & Boyle	Quartz Mountain	Water		10	500	65	6	7	7	2 arrastras.	6,000	8	No. 7.	9		12 00*
App & Co.	Griffin & Co.	Quartz Mountain	Water		25	600	80	6	8	8	4 pans.	25,000	40	40	9	1	4 00
Heslep	B. F. Heslep	Quartz Mountain	Water		10	500	60	7	7	7	3 pans.	10,000	8	50	8		2 00
Trio	Trio company	Whisky Hill	Water		10	400	60	8	6	6	3 pans.	10,000	6	50	9		5 00
Mooney & Co.	Mooney & Co.	Whisky Hill	Water		4	800	40	10	7	7		2,000	5	No. 7.	8		2 00
Oliver & Harris	Oliver & Harris	Whisky Hill	Water		10	600	65	9	8	8	1 arrastra.	12,000	10	50	8		6 00
Reist	Reist	Whisky Hill	Water		5	500	55	8	7	7		5,000	6	50	8		3 00
Rawhide	New York company	Rawhide Ranch	Steam	80	20	600	70	8	8	8	8 pans.	30,000	25	50	8		8 00*
Patterson	Patterson	Tuttletown	Water		10	500	60	8	7	7		5,000	8	50	8		3 00
Musser	Musser	Tuttletown	Water		5	500	60	8	7	7		5,000	5	50	8		5 00
Soulsby	D. Davidson	Soulsbyville	Wt'r & st.	30	20	500	60	10	7	7	2 pans.	30,000	20	50	8		20 00*
Starr King	Mr. Inch	North Fork Tuolumne	Steam	15	5	500	60	8	7	7		6,000	5	50	8		15 00*
Gilson	Eastern company	Soulsbyville	Steam	20	10	500	60	8	7	7		10,000	10	50	8		8 00*
Grizzly	Eastern company	North Fork Tuolumne	Water		20	500	60	8	7	7		25,000	20	50	8		8 00*
Bonita	Eastern company	North Fork Tuolumne	Water		10	500	60	8	7	7		20,000	10	50	8		8 00*
Consuello	Eastern company	North Fork Tuolumne	Water		10	500	60	8	7	7		20,000	10	50	8		8 00*
Martin	Martin	Sugar Pine	Water								2 arrastras.	1,500	2				10 00*
McCurdy & Co.	McCurdy & Co.	Campo Seco	Water								3 arrastras.						5 00
Monitor	Daegennes & Co.	Sugar Pine	Steam	15	5	500	60	8	7	7		8,000	5	50	8		10 00*
Hazel Dell		Five-mile Creek	Water		5	500	60	8	7	7		5,000	5	50	8		8 00*
Shanghai	Gashwiller & Co.	Yankee Hill	Water		10	500	60	8	7	7		8,000	10	50	8		8 00*
Hunter	Manning and Co.	Big Cañon	Water		10	500	60	8	7	7		10,000	10	50	8		10 00*
Sell & Martin	Eastern company	Bald Mountain	Water		15	600	60	8	7	7		20,000	15	50	8		10 00*
Nonpareil		Big Oak Flat	Water		5	500	60	8	7	7	2 pans.	8,000	5	50	8		10 00*
Burns & Co	Burns & Co.	Garote	Steam	25	10	500	60	8	7	7	3 pans.	15,000	10	50	8		8 00*
Rattlesnake	Incorporation	Big Oak Flat	Steam	30	10	500	60	8	7	7		12,000	10	50	8		10 00*

N. B.—Most of these mills are idle.

*** Including mining, I suppose.—R. W. R.**

***Remarks.*—This county comprises one district; several smaller districts were formed, but they are not generally recognized. The list of mills comprises thirty. There are many other mines besides those which own the above mills, and which are partially worked, or have their ore crushed at some of the above mills. The pans which are used are the Varney, Wheeler, and Hepburn. Some of the data are estimated, and may not be exactly correct. The fall of stamps varies from six to ten inches; the height of screens from eight to ten inches. In my estimate of treatment in some mills the figures are based upon the character of the rock and mode of working. They will not vary much either way from the true cost. You will notice but few steam mills. This county has superior advantages for cheap water power. Even what few steam mills there are, could be changed to water mills; it is much cheaper than steam.**

Estimate of costs of mining and reducing ores in Tuolumne County district, Tuolumne County, California, reported by W. G. Heslep, July 1, 1869.

Wages of first-class miners: Three dollars per day.

Wages of second-class miners: Two dollars to two dollars and fifty cents per day.

Wages of surface laborers: Two dollars; Chinese, seven to nine dollars per week.

Cost of lumber: Two dollars per thousand.

Cost of mining timber: Four cents per running measure, twenty-five dollars per thousand.

Cost of common powder: Three dollars and fifty cents to four dollars per keg.

Cost of giant powder: One dollar and fifty cents per pound.

Cost of quicksilver: Sixty to sixty-five cents per pound.

Cost of freight from San Francisco: one and a quarter to two cents per pound.

Cost of fuel: Five dollars per cord; in timber region, three dollars.

Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Eight thousand dollars.

Cost of twenty-stamp mill, freight, erection, &c.: Fifteen thousand dollars.

Minimum mining cost per ton of ore: One dollar; two dollars; four dollars.

Mines from which this is reported: Heslep, Golden Rule, Griffin.

Character of rock at those mines: Talc and chloritic slate and quartz; slate and quartz; quartz.

Depth of mines: One hundred and sixty feet; one hundred and fifty feet; four hundred feet.

Maximum mining cost per ton: Forty dollars; six dollars; six dollars.

Character of rock, &c.: Quartz, containing antimonial sulphide.

Minimum reduction cost: Three dollars per ton.

Name of mill, and number of stamps: Rawhide Mill; twenty stamps.

Character of process employed: Battery amalgamation and pans.

Maximum milling cost: Ten dollars.

Name of mill, and number of stamps: Confidence Mill; twenty stamps.

Character of process employed: Battery amalgamation and pans.

Average mining cost per ton: Four dollars.

Average milling cost per ton: Two dollars.

Average yield of ore: Fifteen dollars.

Remarks.—A water mill with pans and ten stamps will cost $10,000. Without pans $8,000. Steam mill with pans $12,000. Without, $10,000. Some of the above is estimated, but as near the facts as was possible to ascertain in the short time allowed me.

Return of the production of gold and silver for the Golden Rule mine, Tuolumne County, California, for the year ending July 1, 1869, *reported by Wm. Bosworth.*

Mill, Golden Rule; owner, corporation; location, Tuolumne County, two and a half miles south of Jamestown; mine, gold; number of tons of ore, 3,670; average yield, $6 05; total product, $2,204 32; time of running, 280 days; average number of stamps running, 15; whole number of stamps in mill, 15; power, water.

Remarks.—This company is noted for having paid dividends for several years on low grade quartz.

Estimate of the costs of mining and reducing ores at Golden Rule Mine, Tuolumne County, reported by W. Bosworth, president of the company, July 1, 1869.

Wages of first-class miners: Three dollars per day.

Wages of second-class miners: Two dollars and fifty cents per day.

Wages of surface laborers: Two dollars and fifty cents per day.

Cost of lumber: Twenty-five dollars per thousand.

Cost of mining timber: Nine to twelve cents per running foot.

Cost of common powder: Three dollars per keg.

Cost of quicksilver: Sixty-five cents per pound.

Cost of freight from Stockton: One and one-eighth cent per pound.

Cost of fuel: Oak, five dollars per cord.

Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Seven thousand dollars—water power.

Cost of twenty-stamp mill, freight, erection, &c.: Fourteen thousand dollars.

Minimum mining cost per ton of ore: Three dollars and fifty cents.

Mine from which this is reported: Golden Rule.

Character of rock at that mine: Slate and quartz.

Depth of mine: Two hundred and ten feet.

Milling cost: From one dollar and fifty cents to one dollar and seventy-five cents per ton. Amalgamation in battery.

Character of process employed: Battery, shaking tables, copper plates, and arrastra.

Average yield of ore: Six dollars and five cents per ton, (from the secretary's report for twelve months ending July 13, 1869.)

Exhibit of producing mines in Blue Gulch district, Tuolumne County, California, on July 1, 1869, *reported by Peter Musser.*

Name.	Owner.	Character.	Course.	Dip.	Dimensions of claims.
Eagle Mine	Philadelphia Co	Lode	N.E. S.W. 50°	E. 70°	2,200 feet.
Shawmut Mine	Boston Co	Lode	N.E. S.W. 50°	E. about 70°.	750 feet.
Jacksonville Mine or Clio	New York Co	Lode		E	

Name.	Country rock.	Vein matter.	Ore.	Average value.	Mills.
Eagle Mine	Blue slate.	Banded quartz and slate.	Banded quartz.	$10 54 per ton	1 ten-stamp.
Shawmut Mine	Slate		Banded quartz.		1 Moor's grinders.
Jacksonville Mine or Clio.	Blue slate		Banded quartz		1 ten-stamp.

The claims are on the mother lode.

Remarks.—The Shawmut and Clio mines are not worked. The Eagle has been worked since 1864 until last fall, when an excess of water compelled the company to put up pumps, also making repairs on the mill. This we have done, and will work the mine again next month. We put up thirty-foot overshot water-wheel for the pump at mine. We also retimbered the shaft. Cannot give date of discovery nor organization of this district. Population small. Chinese camp buys placer gold—$3,000 per week. Eagle mine work three chimneys together, three hundred feet long. Vein matter, twelve feet wide. Pay ore from two to six feet wide. Pay on foot wall banded quartz; between pay and hanging wall, quartz and slate, with some gold; between pay and foot-wall, soft and very black slate, three inches to two feet wide, easily removed with a pick. The $10 54 per ton is the average of 2,200 tons.

Estimate of cost of mining and reducing ores in Blue Gulch district, Tuolumne County, California, reported by Peter Musser, July 1, 1869.

Wages of first-class miners: Three dollars per day.

Wages of second-class miners: Two dollars and fifty cents per day.

Wages of surface laborers: Two dollars and fifty cents per day.

Cost of lumber: Twenty-five dollars per thousand feet.

Cost of mining timber: Ten to fifteen cents per foot.

Cost of common powder: Two dollars and seventy-five cents per keg.

Cost of giant powder: One dollar and twenty-five cents per pound.

Cost of quicksilver: Sixty to seventy cents per pound.

Cost of freight from San Francisco now: Seven-eighths per hundred-weight.

Cost of fuel: Wood, four dollars per cord.

Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Eight thousand to nine thousand dollars, (estimated.)

Cost of twenty-stamp mill, freight, erection, &c.: Fourteen thousand to fifteen thousand dollars.

Minimum mining cost per ton of ore: Five dollars and fifty cents per ton, including hoisting and pumping.

Mine from which this is reported: Eagle Mine, Blue Gulch, Tuolumne County.

Character of rock at that mine: Banded quartz.

Depth of mine: Three hundred and seventy-five feet.

Maximum milling cost: One dollar and twenty-five cents per ton.

Name of mill, and number of stamps: Eagle Mill, ten stamps, free water.

Character of process employed: Stamps and copper plates.

Average yield of ore: Ten dollars and fifty-four cents per ton.

Remarks.—Power at mill, free water, sufficient to drive fifty stamps. At mine, hoisting, thirteen-horse steam-power. Pumps, five-inch plunger. Power, thirty feet overshot water-wheel. Capacity of wheel one hundred inches water.

Our sulphurets pay, by chlorination, $200 per ton. Quantity two per cent., or two tons to every one hundred tons of ore.

Exhibit of Tuolumne Mountain mine, Tuolumne County, on the 1st *day of July*, 1869, *reported by secretary of company.*

Name, Tuolumne Mountain; owner, incorporated; character, vein; course, northeast to southwest; dip, 30° west; dimensions of claim, 1,650 feet; country rock, slate and granite; vein matter, a quartz mixed with cap rock, decomposed quartz, and slate; ore, a gray and blue quartz, showing free gold, and a large quantity of sulphurets; average value per ton, $30; mills, one. The mill is very poor and inefficient—light stamps; product for the year ending July 1, 1869, gross, $30,000; net, $18,000. Not worked steadily.

Estimate of costs of mining and reducing ores at Tuolumne Mountain Gold and Silver Mining Company mine, Tuolumne County, California, reported by ———, *July* 1, 1869.

Population of district: Two hundred.

Wages of first-class miners: Fifty dollars per month and found.

Wages of second-class miners: None employed.
Wages of surface laborers: None employed.
Cost of lumber: Forty dollars per thousand, (whip-sawed.)
Cost of mining timber, $40 per thousand, (whip-sawed.)
Cost of common powder: San Francisco prices, freight added.
Cost of giant powder: San Francisco prices, freight added.
Cost of quicksilver: San Francisco prices, freight added.
Cost of freight from Sonora: Two and three cents per pound, (ten miles packing.)
Cost of fuel: Can be had for the price of chopping, $1 75 per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: $10,000.
Minimum mining and milling cost per ton of ore: Twelve dollars.
Mine from which this is reported: Tuolumne Mountain Gold and Silver Mining Company.
Character of rock at that mine: Gray and blue quartz, free gold, and gold sulphurets.
Depth of mine: One hundred and ninety feet.
Maximum mining and milling cost per ton: Fourteen dollars.
Number of stamps in mill: Ten.
Character of process employed: Wet, common battery.
Average yield of ore: Thirty dollars per ton.

Remarks.—There is a tunnel in this mine of four hundred feet in length, striking the ledge at the depth of about two hundred feet. The ten-stamp mill, the stamps being light, crushes only from four to five tons per day. Facilities of communication are slight, and enhance expenses considerably.

CHAPTER V.

CALAVERAS COUNTY.

Although this county has no great results to boast of in either quartz or placer mining, there has nevertheless much activity prevailed during the year. The Mattison has had its shaft deepened to three hundred feet, and shows a more solid ledge at that depth, the slaty matter having given room to quartz. A Hogan & Water furnace has been erected at this mine for the roasting of sulphurets. The shaft of the Union mine is now one hundred and fifty feet deep, and the vein is here fifteen to twenty feet thick, and all pay-rock. The Bovee, Stickles, Lightner, Utica, Dr. Hill's, and Angel's, all on the same ledge with the Union, have not been producing during the year, although most of them were thought of very highly at one time.

Barney & Co., the Hilaria Company, Lewis Brothers, Mr. Gashwiler, Sheldon, Folsom & Co., and the Petticoat Company, have worked in a small way during the year, and some of them have made satisfactory returns. The Lewis Brothers have crushed forty tons of ore from their so-called "little vein," which are reported as giving quite astonishing results. About one-half of the ore was first-class, the balance second-class rock, and the former is reported as having yielded $214 per ton, while even the second-class is said to have gone as high as $46 per ton. If so, this ore has probably been well sorted; but even at that such a result will undoubtedly lead to renewed energy and activity in the mines of the neighborhood.

From the placer mines of the county I have no satisfactory reports. In the neighborhood of Calaveras Town gravel-mining has been carried on in a small way by Chinese and others, and about $6,000 worth of dust was sold per week in town during part of the spring. The old Union shaft has been cleared of water and much gravel of high grade was taken out; it was also ascertained that a great portion of that formerly worked will pay for re-washing. On the whole the claims worked have paid only moderately, and big strikes have been of rare occurrence.

The discovery of extensive iron ore deposits, five miles from Calaveras, is reported.

Return of the production of gold and silver in the Lower Calaveritas mining district, Calaveras County, California, for the year ending July 1, 1869, reported by John Rathgeb.

Mill.	Owner.	Location.	Mine.	No. tons quartz crushed.	Average yield per ton.	Total product.	Time running, days of 24 h.	Av. No. stamps running.	No. of stamps in mill.	Power.	Remarks.
Union Quartz Mill	Union Gold Mining Co., (incorporated.)	Calaveritas Creek, 3 miles south of San Andreas.	Union mine...	*100	*$20	*$2, 000	*14	10	10	Water, 30 inches† on 36 feet overshot wheel.	Gold fineness 920 thousandths, silver fineness 61 thousandths.
Thorpe's Arrastra Mill. ‡	Captain Thorpe	Fourth Crossing, or Foorman's Ranch, 4 miles south of San Andreas.	Thorpe's mine	*600	*7	*4, 200	350	‡None	‡None	Water, 30 inches† on 24 feet overshot wheel.	Gold fineness 932 thousandths, silver fineness 58 thousandths.

* Estimated. † Miners' inches, a pressure of six inches. ‡ Three arrastras of nine feet diameter, made of granite.

Exhibit of producing mines in Lower Calaveritas mining district, Calaveras County, California, on July 1, 1869, reported by John Rathgeb.

Name.	Owner.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Ore.	Av. val. pr. ton.	Mills.	Product for the year ending July 1, 1869.
Union Mine ...	Union Gold Mining Co.	Lode	N.W.-S.E.	Little to E.	1,400 ft. long, 200 ft. wide.	Gray slate, hard.	Quartz, quartzose slate, talcose slate with pyrites, cubical and in slabs, and decomposed. Soft. Dry.	Auriferous quartz.	$20	1 10-stamp, by water.	300 tons extracted, 100 tons crushed, $2, 000 cash.
Thorpe's Mine in Foorman's district.	Capt. Thorpe.	Lode	N.W.-S.E.	East ..	*1, 200 feet.	Blue and gray slate.	Quartz, limestone, talcose slate and blue slate, with small pyrites and irregular deposits of sulphurets containing gold. Easily extracted. Water.	Auriferous slate.	7	1 3-arrastra, by water.	1,000 tons extracted, 600 tons ground, $4, 200 cash.

* Estimated.

Remarks.—These are the only mines in both districts having mills and doing regular business. In San Andreas district there is no quartz mill at present, and but two mines of any interest, B. Thorne's and Seiffert's, but no work done. The remaining lodes are undeveloped for want of energy.

NOTE.—The Union mine was discovered in September, 1861, (Thorpe's mine about the same time,) but has only been worked for two years. Seiffert's mine has produced about 200 tons, average $8 to $10 per ton. B. Thorne's had none crushed, but has flattering prospects. J. R.

Estimate of costs of mining and reducing ores in Lower Calaveritas mining district, Calaveras County, California, reported by J. Rathgeb, July 1, 1869.

Population of district: About twenty-five, all included.

Wages of first-class white miners: Fifty dollars and board per month.

Wages of second-class white miners: Thirty-five dollars and board per month.

Wages of surface white laborers: Thirty dollars and board per month.

Cost of lumber: Twenty-five dollars per thousand feet, delivered.

Cost of mining timber: Twenty-five dollars per thousand feet, delivered.

Cost of common powder: Not used.

Cost of giant powder: Not used.

Cost of quicksilver: Sixty-five cents per pound.

Cost of freight from Stockton to San Andreas: Fifty to seventy-five cents per hundred pounds.

Cost of ten-stamp water mill, California pattern, including freight, erection, &c.: Four thousand dollars.

Minimum mining cost per ton of ore: Two dollars.

Mine from which this is reported: Union mine.

Character of rock at that mine: Gold-bearing quartz, opal, brittle, no sulphurets.

Depth of mine: One hundred and fifty feet.

Maximum mining cost per ton: Two dollars and fifty cents.

Mine from which this is reported: Union mine.

Character of rock, &c.: Gold-bearing quartz.

Minimum reduction cost: Fifty cents per ton.

Name of mill, and number of stamps: Union Mill; ten stamps, free water.

Character of process employed: Wet stamp crushing, amalgamating in battery.

Maximum milling cost: Fifty cents per ton.

Average mining cost per ton: Two dollars and fifty cents.

Average milling cost per ton: Fifty cents.

Average pulp-assay of ore: Irregular, gold coarse in places.

Average yield of ore: Fifteen dollars per ton.

Remarks.—The quartz lode varies in width; five feet is about an average.

List of mills in San Andreas and Lower Calareritas mining district, Calaveras County, on July 1, 1869, *reported by John Rathgeb.*

Name of mill, Union Mill; owners, Union Gold Mining Company; location, Lower Calaveritas; kind of power, water; horse power of engine, ———; number of stamps, ten; weight of stamp, five hundred pounds; number of drops per minute, sixty; height of drop, eight to ten inches; diameter of die, six inches; diameter of shoe, seven inches; cost of mill, $4,000; crushing capacity per day, eight to ten tons; size of screen, one by four feet; height of screen above die, three to five inches; cost of treatment, per ton, thirty-seven and a half cents for wages, and twelve and a half cents for wear and tear, &c.

Report on West Point mining district, by Ira H. Reed.

Population of district, five hundred.

Number of quartz mills, five, viz: One battery mill of eight stamps, known as the Saca Tierra mill; one of five stamps, known as Sterling mill; one arrastra mill with two arrastras, known as the Carlton mill; one ditto, known as Schmidt's mill; and one ditto, known as the Morris mill.

These mills are all run at present on custom rock, with the exception of the Saca Tierra, which, with the mine, was lately sold to Gawne and Frank, who are now running the mill on rock from the mine.

The Sterling mill is not doing much, nor has it been doing much the past year.

Schmidt's mill, with two arrastras, has crushed 260 tons up to date during the past year, averaging $50 per ton.

Carlton's mill has, probably, crushed 100 tons for the same time, averaging $30 per ton.

Cannot say correctly what the Morris mill has done for the past year, but, perhaps, has not crushed over 50 tons of $20 ore.

These arrastra mills seem to have the preference among miners here as saving more gold than the batteries, though they run at higher cost and employ a slower process. Arrastras are twelve feet in diameter, and driven by spur wheels on each end of the water-wheel shaft. They grind two charges of four cargoes each (a cargo being 300 pounds) per twenty-four hours, a primitive battery of two or three stamps being used to crush or break the rock small enough for the arrastras before charging them. After the arrastras have run about four hours quicksilver is added to the pulp.

Much of our rock goes out of the district, viz., to Harris's mill, (a five-stamp battery,) in Sandy Gulch, to be crushed. Probably 200 tons, averaging $25 per ton, have been crushed there during the past year from here.

All our mills are driven by water-power, and have overshot wheels. The charge for grinding rock is $5 per ton in a battery mill, and $6 66 in an arrastra. Cost of hauling averages about $1 50 per ton.

The country rock is granite, and blasting ground is found sometimes from the surface and sometimes commencing as low as 150 feet in depth. Generally the cost o extracting the ore from hard ground is so much that claims will not pay. The ledge are small and irregular, pay chimneys or bunches occur in groups, and when down t hard ground the gold is of poorer quality, and more difficult to amalgamate. A genera theory exists that by going down in some of these localities, where many paying bunche have been met, that a main mother ledge will be found; but as yet no effort has been mad to prove the correctness of this theory, about 160 feet being the greatest depth reached

Cost of labor, $3 per day, (first-class;) second-class, (Chinese,) $1 50 per day. Cos of lumber, $25 per thousand.

CHAPTER VI.

AMADOR COUNTY.

This county, though the smallest in the State, has kept up its reputation as one of the most successful quartz mining counties. Not alone have the mines, already well known by their almost unexampled yield of gold during the past, maintained their production, but also comparatively new, or at least almost unknown, mines, have contributed t swell the aggregate product of the year. Among the latter may b named the Summit mine, on Sutter Creek; the Lincoln mine, one and a half mile north of the celebrated Hayward; and the Towbridge mine in the edge of Jackson. The Lincoln mine has erected new and complete hoisting works, and the Summit mine has struck very rich ores i their lowest (four hundred feet) level. The new chlorination works o Sutter Creek are in successful operation.

The Hayward or Amador mine (claim 1,850 feet long) has struck ver rich ores and opened up large reserves in the lowest levels during th latter part of 1868; it is now 1,350 feet deep. In some of the uppe levels important discoveries of valuable ore have also been made. Th Badger shaft has been sunk over four hundred feet since last year, so tha it is now one hundred and fifty feet deeper than the lowest level in th mine a year ago. It has passed through a new and very rich body of ore

The following statements of receipts, disbursements, cost of mining an milling, &c., for the year 1869, are taken from the report of the company

RECEIPTS.	
Cash on hand December 31, 1868	$11,681 5
Bullion	656,326 7
Sundries	38,072 2
	706,080 6

DISBURSEMENTS.	
Mine account	$160,447 7
Construction account	25,885 7
Eureka Mill	35,161 2
New Mill	32,366 5
Salary account	11,922 5
Dividends 13, at $8 per share	384,800 0
Sundry accounts	52,356 2
Cash on hand	2,140 5
	706,080 6

The total assets are stated at $160,494 72. The ore to produce th above amount of bullion aggregated 32,510 tons, yielding, therefore $20 19 per ton. Cost of mining 32,510 tons, $4 86½; milling, $1 97½ total, $6 83¾ per ton.

From the Keystone I have not been able to obtain full returns. It approximate yield, however, throughout the year, has been about $25,00 gross and $15,000 net per month.

Return of the production of gold and silver in the Sutter Creek mining district, Amador County, California, for the year ending July 1, 1869, reported by E. W. Hatch.

Mill.	Owner.	Location.	Mine.	Number of tons of ore.	Average yield.	Total product.	Time of running, in days.	Average number of stamps running.	Whole number of stamps in mill.	Power.
Eureka	Amador Mining Company	Sutter	Amador	30, 361	$20 34	$617, 542 96	28	72	72	Steam and water
Badger	Amador Mining Company	Sutter	Amador							
Rose	Amador Mining Company	Sutter	Amador							
Keystone	Keystone Consolidated Mining Company	Amador	Keystone	6, 456	....	*300, 000 00	29	20	20	Steam.

* Estimated.

Exhibit of producing mines in Sutter Creek mining district, Amador County, California, on July 1, 1869.

Name.	Owner.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Ore.	Average value.	Mills.	Product for the year ending July 1, 1869.
Amador	Amador Mining Company	Lode	N. N. W.	East	Length, 1, 850 feet	Granite east, slate on west.	Quartz	Gold	$21 56	3	$617, 542 96
Keystone	Keystone Con. Mining Company	Lode	N. N. W.	East	Length, 2, 800 feet	Granite east, slate on west.	Quartz	Quartz, sulphurets, gold.	....	1	*300, 000 00
Oneida	Oneida Mining Company	Lode	N	East	....	Granite east, slate on west.	Quartz	Quartz, sulphurets, gold.	....	1	No returns.

* Estimated.

List of mills in Sutter Creek mining district, Amador County, on July 1, 1869, reported by E. W. Hatch.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Horse-power of engine.	Number of stamps.	Weight of stamp.	Number of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	Number and kind of pans.	Cost of mill.	Crushing capacity per day.	Heighth of screen above die.	Amount of wood consumed per day.	Cost of treatment per ton.
								In.					*Tons.*	*In.*	*Cords.*	
Eureka	Amador Mining Company	Sutter Creek	Both	70	40	650	76	9	8	8	2 pans—Hepburn	$35,000	*75	6	7	$2 20
Badger	Amador Mining Company	Sutter Creek	Water	....	16	500	79	....	7	7	None	21,000	17	10	....	2 05
Rose	Amador Mining Company	Sutter Creek	Water	....	16	500	....	....	7	7	None	16,000	20	10	....	2 05
Lincoln Mill	Lincoln Quartz Mining Company	Sutter Creek	Water	....	20	450	79	9	7	7	None	....	24	11	....	2 05
Mahony Brothers	Mahony Brothers	Sutter Creek	Water	....	15	600	70	11	11	7	None	10,000	20	9	....	3 03
Mahony	J. Mahony	Sutter Creek	Water	....	12	600	70	11	11	7	1 pan—Knox	7,000	15	......	....	3 00
Keystone	Keystone Consolidated Mining Company	Amador	Steam	30	20	600	74	9	8	8	2 pans—Hepburn	17,000	32	8	6	2 20

* I have given the full capacity of the new mill, which is just completed. The capacity of the old Eureka was 52 tons per day, with nothing but copper plates and sulphuret blankets. The old mill was running up to the 1st of July.

Remarks.—The Eureka mill runs by water about seven months, and by steam the balance. Amalgamate in battery, use copper plates and blankets, two Hepburn pans, two settlers, and two Cornish buddles. The Keystone amalgamate the same way; two pans, one settler, two Hungerford concentrators, and one Cornish buddle.

I have given the full running capacity of all the water mills on the creek, but owing to the low stage of water in the creek at certain seasons of the year, (the summer,) it is mpossible to make full time. In August last the Badger only made twelve days, and the Rose twenty; all other water mills the same way.

imate of costs of mining and reducing ores in Sutter Creek district, Amador County, California, reported by E. W. Hatch, July 1, 1869.

opulation of district: Twelve hundred.
ages of first-class miners: Three dollars per day.
ages of second-class miners: Two dollars sixty-two and a half cents per day.
ages of surface laborers: Two dollars and twenty-five cents per day.
ost of lumber: Twenty-eight dollars per thousand feet.
ost of mining timber: Four dollars, average.
ost of common powder: Two dollars and seventy-five cents per keg of 25 pounds.
ost of giant powder: One dollar and twenty-five cents per pound.
ost of quicksilver: Sixty-five cents per pound.
ost of freight from San Francisco: Twenty dollars per ton.
ost of fuel: Five dollars and fifty cents per cord.
inimum mining cost per ton of ore: Four dollars.
Mine from which this is reported; Amador.
Character of rock at that mine, main vein: Bluish ribbon rock.
Depth of mine: Thirteen hundred and fifty feet.
aximum mining cost per ton: Five dollars and twenty-five cents.
Mine from which this is reported: Amador.
haracter of process employed: Wot crushing.
verage mining cost per ton: Four dollars and sixty-seven cents.
verage milling cost per ton: Two dollars and fifteen cents.
verage pulp-assay of ore: Twenty-seven dollars and thirty-eight cents.
verage yield of ore: Twenty dollars and thirty-four cents.
emarks.—The average yield of ore from the mine for the year 1869, will be 3,000 tons month.

of mining claims in Foster mining district, Amador County, California, on July 1, 1869, reported by John Nichols.

ame, Marklee Mine; owner, Hanson Marklee; character, vein; course, northwest l southeast; dip, northeast; dimensions of claim, twelve hundred feet; country k. slate; vein matter, quartz and spar; ore, gold-bearing quartz; value per ton, rty dollars to sixty dollars, by mill prices.

t of mills in Foster mining district, Amador County, California, on July 1, 1869, reported by J. Marklee.

ame of mill, Tynan Mill; owner, J. Foster; location, Dry Creek; kind of power, am; horse-power of engine, twelve; number of stamps, twelve; weight of stamp, r hundred pounds; number of drops per minute, seventy-five; height of drop, ten hes; diameter of die, eight inches; diameter of shoe, eight inches; cost of mill, 00; crushing capacity per day, eight tons; size of screen, thirty-two by nine inches; ight of screen above die, twelve inches; amount of wood consumed per day, one and -fourth cord; cost of treatment per ton, three dollars.

Remarks.—The owners of this mine (Marklee mine) are suffering very much for the nt of a better mill or process for reducing the ore; a great deal of the gold is conned in a sulphuret, and the process we have saves only the free gold.

timate of costs of mining and reducing ores in Foster district, Amador County, California, reported by J. Marklee, July 1, 1869.

Population of district: Thirty persons.
Wages of first-class miners: Sixty dollars per month, with board.
Wages of second-class miners: Fifty dollars per month, with board.
Wages of surface laborers: Forty dollars per month, with board.
Cost of lumber: Sixteen dollars per thousand.
Cost of mining timber: Two dollars per hundred feet, running measure.
Cost of common powder: Five dollars per keg, eastern powder.
Cost of quicksilver: Seventy-five cents per pound.
Cost of fuel: Two dollars and fifty cents per cord.
Mine from which this is reported: Marklee mine.
Character of rock at that mine: Fine-grained ribbon quartz.
Depth of mine: One hundred feet.
Maximum mining cost per ton: Six dollars.
Minimum reduction cost: Three dollars.
Name of mill, and number of stamps: Tynan mill, twelve stamps.
Character of process employed: Simple stamping, and amalgamating in battery on pper plates.
Average pulp-assay of ore: Sixty dollars per ton.
Average yield of ore: Thirty dollars per ton.
Remarks.—This mine was discovered and located October 12, 1868. We use for hoisting rk from the mine, horse-power. Names of the owners of mine, J. Marklee, J. Nichols, illiam Hanson.

CHAPTER VII.

ELDORADO COUNTY.

This county, the first in which gold was discovered in California, and which has yielded very large returns in the earlier periods of gold-mining, has very little successful mining to boast of during the last year. The rich bars along the several forks of the American River have ceased to pay, and few quartz mines have produced satisfactory results. The only exceptions are perhaps the Pacific mine, near Placerville, the owners of which have found it profitable to add another battery to their mill; the Crystal, which has produced from sixty to eighty ounces per week, extracted by an eight-stamp mill; the Stillwagon, which has kept its five-stamp mill busy most of the time; and the Independence, at Brownsville, the ore from which pays from twenty-five to forty dollars per ton in free gold. The sulphurets from this mine assay over one hundred dollars per ton.

In this county, near Smith's Flat, is situated the Silicon mine, a mine which furnishes large quantities of an infusorial earth. This material is used extensively, under the name of electro-silicon, for the polishing of all kinds of metals, and also for the manufacture of dynamite.

The annexed are the only tabular returns received from Eldorado County:

List of mills in Placerville, California mining district, El Dorado County, on July 1, 1869, reported by John F. Pinkham, Agent Wells, Fargo & Co.

Name of mill.	Owners.	Location.	Kind of power—water or steam.	Horse-power of engine.	Number of stamps.	Weight of stamp.	No. of drops per minute.	Height of drop—inches.	Diameter of die.	Diameter of shoe.	No. and kind of pans.	Cost of mill.	Crushing capacity per day—tons.	Size of screen.	Height of screen above die—inches.	Amount wood consumed per day—cords.	Cost of treatment per ton.
Pacific	J. M. Douglass	Placerville	Steam	37	10	500	75	8	8	7½	......	$2,000	10	6	7	2½	......
Harmon	Thos. Price & Co.	Placerville	Steam	30	15	300	75	8	6	......	......	......	12	......	......	......	......
Reed	Reed & Co.	Placerville	Water	......	10	600	75	8 to 12	8	8	......	......	15	6	11	......	$3 00
Independence	McLane & Swan	Mendon	Water	......	12	665	80	9	8	8	1*	14,000	18	7	11	......	2 00
Crystal	Crystal company	Mendon	Water	......	8	650	70	9	8	8	......	4,500	12	6	11	......	2 00
Stillwagon	Stillwagon & Norton	Mendon	Water	......	5	400	65	9	6	6	......	3,000	5	6	9	......	3 00
Star Mill	McGruder & Baker	Mendon	Steam	10	8	400	80	9	7	7	......	3,500	10	6	11	2	4 00
Taft's, (cement mill)	P. M. Taft	Smith's Flat	Steam	8	10	350	75	9	10	6	......	2,000	16	¼	4	1½	62½
Confidence	Alter & Co.	Cedar Ravine	Steam	5	6	300	80	7	6	6	......	2,000	10	¼	14	1	2 00

* Concentrator.

Estimate of costs of mining and reducing ores in Placerville district, El Dorado County, California, reported by John F. Pinkham, July 1, 1869.

Population of district: About five thousand.
Wages of first-class miners: Three dollars to three dollars and fifty cents per day.
Wages of second-class miners: Two dollars to two dollars and fifty cents per day.
Wages of surface laborers: Two dollars per day.
Cost of lumber: Twenty dollars per thousand feet.
Cost of mining timber: Eight dollars per cord.
Cost of common powder: Three dollars per keg.
Cost of giant powder: Sixty-two and a half cents per pound.
Cost of quicksilver: Sixty-seven cents per pound, by flask.
Cost of freight: From Shingle Springs, twenty-five cents per hundred; from Sacramento, eight dollars per ton.
Cost of fuel: Four-foot wood, five dollars to six dollars per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: From five thousand to twenty thousand dollars.
Cost of twenty-stamp mill, freight, erection, &c.: From ten thousand to thirty thousand dollars.
Minimum mining cost per ton of ore: Two dollars.
  Mine from which this is reported: Crystal.
  Character of rock at that mine: White quartz.
Maximum mining cost per ton: Three dollars.
  Mine from which this is reported: Epley, water power; steam, four dollars.
  Character of rock, &c.: White quartz, with sulphurets.
  Depth of mine: Two hundred and eighty feet.
  Character of process employed: Sluices, with quicksilver.

CHAPTER VIII.

PLACER COUNTY.

Although mining during the last year can neither in activity nor in prosperity be compared to that of former times, it must nevertheless be conceded that hydraulic mining at least has been quite lively, especially in the neighborhood of Forest Hill.

Quartz mining has been followed in a number of claims, but none can be called a success so far except the Rising Sun mine.

I should perhaps mention here the discovery of very extensive iron-ore deposits six miles from Auburn. The claim belongs to Brown & Co., and the ore shipped so far to the Pacific rolling mills of San Francisco has given very satisfactory results, as it is very rich and pure. The shipping is done by way of Clipper Gap, Central Pacific railroad, and the nearness of this station gives the deposit great advantages of transportation over all the other iron-ore mines in California.

The following tables include fuller reports from the placer mines than I have been able to procure from any other county:

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Ore.	Average value.	Mills.	Product for the year ending July 1, 1869.
Live Oak	Egbert & Hodgdon	Quartz vein	North and South.	West	1,250 feet	Slate	Quartz		$25 per ton	1	None taken out.
Rising Sun Mining Company.	Incorporated company.	Vein	65° East		3,000 feet	Granite and trap.	Quartz	Free gold & sulph.	About $25	1	About 40,000.

List of mills in Colfax mining district, Placer County, California, on July 1, 1869, reported by H. Rosewarn.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Number of stamps.	Weight of stamp.	Number of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	Number and kind of pans.	Cost of mill.	Crushing capacity per day.	Size of screen.	Height of screen above die.	Amount of wood consumed per day.	Cost of treatment per ton.
							Inch.	*Inch.*	*Inch.*			*Tons.*		*Inch.*	*Cords.*	
Live Oak	Egbert & Hodgdon	Live Oak Ledge	Water.	5	600	60	12 in.	8	8		$4,000	10				$4 00
Rising Sun	Incorporated company		Steam	5	800	65	11 in.	9	9	1	*2,500	10	10 by 12	3	3	*2 50

Remarks.—The engines both hoist and pump water with the above amount of wood, (in the Rising Sun mine.)

* About.

Estimate of costs of mining and reducing ores in Colfax district, Placer County, California, reported by H. Rosewarn, July 1, 1869.

Wages of first-class miners: Three dollars per day.
Wages of surface laborers: Two dollars and fifty cents per day.
Cost of lumber: Eighteen dollars per thousand feet.
Cost of mining timber: Fourteen dollars per thousand feet.
Cost of common powder: Two dollars and fifty cents per keg.
Cost of quicksilver: Sixty-five cents per pound.
Cost of freight from Sacramento: Five dollars and fifty cents per ton.
Cost of fuel: Three dollars per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Three thousand five hundred dollars.
Minimum mining cost per ton of ore: Five dollars.
  Mine from which this is reported: Live Oak.
  Character of rock at that mine: Blue quartz.
  Depth of mine: Tunnel, back end, one hundred and twenty-five feet.
Maximum mining cost per ton, ———.
  Mine from which this is reported: Rising Sun.
  Character of rock, &c.: Blue quartz.
  Depth of mine: Two hundred and thirty feet.
  Name of mill, and number of stamps: Rising Sun.
  Character of process employed: Blankets and pan.
Average mining cost per ton: Ten dollars.
Average milling cost per ton: Three dollars.
Average yield of ore: About twenty-five dollars.

Remarks.—In this district there are numerous locations on promising veins; but, with the exception of Rising Sun and Live Oak, none can be characterized as "live" claims.

Estimate of costs of mining and reducing ores in Forest Hill district, Placer County, California, reported by Charles Fett, July 1, 1869.

Population of district: About one thousand.
Wages of first-class miners: Four dollars per day.
Wages of second-class miners: Three dollars per day.
Cost of lumber: Eighteen to twenty dollars per thousand, including delivery.
Cost of mining timber: Ten dollars per thousand for hewn timber, and three to four cents per running foot for split.
Cost of common powder: Three to four dollars per keg.
Cost of giant powder: One dollar and seventy-five cents per pound.
Cost of quicksilver: Sixty to seventy-five cents per pound.
Cost of freight from Sacramento: One dollar per hundred-weight.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Twelve thousand dollars, and seventeen thousand dollars for twenty-stamp mill. A large portion of these two sums is for the digging of the foundation.
Minimum mining cost per ton: Cement and gravel, one to three dollars.
Name of mill, and number of stamps: Paragon, (gravel mill.)
Character of process employed: Common table only.
Average mining cost per ton: One dollar and fifty cents.
Average milling cost per ton: Fifty cents.

Remarks.—The Paragon mill is the only one in operation.

Exhibit of producing mines in Forest Hill mining district, Placer County, California, on July 1, 1869, reported by Charles Fett, Forest Hill.

Name.	Owners.	Character.	Product for the year ending July 1, 1869.
Garden Tunnel	W. H. Craig and H. Goebel	Gravel	$2,000
Rough and Ready	J. Crumpton	Gravel	1,000
Jenny Lind	Dierck, May & Co	Gravel	4,000
New Jersey	G. W. Reamer	Gravel	6,000
Boston	Boston Company	Gravel	3,000
Billy's	Billy's Company	Gravel	4,000
Tiger	H. Huber and A. Pond	Hydraulic	2,000
Mountain	Mountain Company	Gravel and cement	40,000
Uncle Sam	United States Company	Gravel and cement	4,000
Oro Claim	Oro Company	Hydraulic	5,000
Paragon, (in Bath near Forest Hill.)	Wheeler & Breece	Gravel	70,000

Remarks.—The five first-named claims have, within the last year, been engaged in prospecting most of the time. Several other claims added within this district will make the total product full $200,000 or over. This district has very extensive deposits yet, but as the opening thereof is expensive, progress is rather slow without the additional help of capital.

List of mills in Forest Hill mining district, Placer County, California, on July 1, 1869, reported by Charles Fett.

Name of mill.	Owners.	Location.	Kind of power—water or steam.	Horse-power of engine.	No. of stamps.	Weight of stamp.	No. of drops p'r minute.	Height of drop.	Cost of mill.	Crushing capacity of gravel per day.	Amount of wood consumed per day.
								Inch.		*Tons.*	*Cords.*
Paragon	Wheeler & Breece	Bath	Steam	40	20	600	75	10½	$18,000	80	2
Mountain	Mountain Company	Forest Hill	Steam	..	10	650	..	......	13,000	......	......
Hope	G. W. Reamer	Forest Hill	Steam	..	20	600	..	......	19,000	......	......
Oro	Oro Company	Forest Hill	Steam	..	20	600	..	......	17,000	......	......
Big Spring	Big Spring Company	Forest Hill	Steam	..	10	650	..	......	12,000	......	......
Washington	Goddard & Co	Yorkville near Forest Hill.	Water	..	10	......	..	......	6,000	......	......
Westchester	Sears and General McDowell.	Broushy near Forest Hill.	Water	..	10	......	..	......	6,000	......	......
Rough Gold	Davis & Co	Bath	Steam	..	10	......	..	......	13,000	......	......
Golden Gate	Golden Gate Comp'y	Bath	Water	..	5	......	..	......	4,000	......	......

Remarks.—These mills have been built mostly under the influence of the first excitement, so common with Californians. They were bound to have a mill before they knew they had a mine. Their funds have thus been expended, and now they have nothing left to prospect with. All these mills are of first quality and well put up, but lie idle, except the Paragon.

General remarks.—This mining district has very extensive deposits of gold-bearing gravel, and will produce far more gold in the future than it has done. The tunnel claims have been mostly worked out in the front channel, and some of them have paid very rich. But the back channel is almost undisturbed, the Mountain Company being the only one at work therein. The opening of this back channel, as well as that of many other promising mines, is connected with very heavy expenses, and the owners are poor. Capitalists from San Francisco have been looking about here now and then, but little has been done by them. Quartz mining is but little followed, although there are numerous ledges, the croppings of which bear free gold. No ledge has been prospected more than 80 feet in depth. Mr. Fett has done some prospecting on a quartz ledge, and expects to strike the ledge shortly, by tunnel, at a depth of about 350 feet.

List of mills in Lone Star mining district, Placer County, California, on July 1, 1869, reported by E. Jillson.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Horse-power of engine.	No. of stamps.	Weight of stamp.	No. of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	No. and kind of pans.	Cost of mill.	Crushing capacity per day.	Size of screen.	Height of screen above die.	Amount wood consumed per day.	Cost of treatment per ton.
								In.	*In.*	*In.*			*Tons.*		*In.*	*Cords.*	
Green Emigrant	Fay, Thomar & Co	Bald Hill	Steam.	30	20	700	75	10	8	8	2 Varney's.	$20,000	40	No. 5	10	4	$5 00
Pioneer	Gillard & Co	Dry Creek	Water.	......	6	800	60	10	8	8	....	1,500	8 or 10	No. 6	2	1	1 50

Remarks.—The Green Emigrant is crushing but little, and that custom rock; the Pioneer is in litigation, and is not crushing at present.

List of mining claims in Michigan Bluff mining district, Placer County, California, on July 1, 1869, reported by James Gould.

Name.	Owners.	Character.	Country rock.	Wages per day.	Hydraulic.	Dimension.	Year ending July 1, 1869.	Calendar year, 1869. Estimated.
Sage Hill Company	Wm. Smith & Co	Gravel	Granite and slate	$3 00	150 feet pressure	1,000 feet square	$2,500	$3,000
North American Company	Van Eman & Bro	Gravel	Slate	3 50	300 feet pressure	1,000 feet square	22,000	25,000
Pike Hill Company	Eureka Ditch Co	Gravel	Slate	3 50	250 feet pressure	1,000 feet square	8,000	12,000
Eldorado Hill Company	Shain, Seaman & Co	Gravel	Slate	3 00	150 feet pressure	1,500 feet square	4,000	4,000
Franklin Company	Mutchler & Co	Gravel	Granite	3 00	Drifting	2,000 feet square	3,600	3,600
Lightfoot Company	E. Thomas & Co	Gravel	Slate	3 50	150 feet pressure	1,000 feet square	2,500	3,000
McCarty claim	William McCarty	Gravel	Slate	3 00	Placer	1,000 feet square	5,450	6,000
Gap Hill Company	Cooper & Bro	Gravel	Slate	3 00	Drifting	1,500 feet square	1,000	1,000
Morning Star	Penman & Co	Gravel	Slate and granite	3 00	Drifting	5,000 feet square	16,381	20,000
Viola Company	Yule & Co	Gravel	Slate and granite	3 00	Drifting	4,000 feet square	10,000	15,000
Cosumne	Russel & Co	Gravel	Slate	3 00	Drifting	5,000 feet square	2,000	2,000
Sandslide Company	W. Smith & Co	Gravel	Slate	3 00	150 feet pressure	2,000 feet square	2,500	3,000
Snoffer claim	Wm. Schnaffer	Gravel	Slate	3 00	100 feet pressure	2,500 feet square	1,500	1,000
Dam claim	McBride & Co	Gravel	Slate	3 00	Drifting	3,300 feet square	8,000	....
Oro claim	Abrams & Co	Gravel	Slate	3 00	Drifting	4,200 feet square	2,000	2,000
American claim	D. L. Gorman	Gravel	Slate	3 50	250 feet pressure	1,000 feet square	1,500	....
Specimen Company	J. W. Byrd & Co	Gravel	Slate	3 00	100 feet pressure	300 feet square	1,300	....
Kavenaugh Company	Kavenaugh & Co	Gravel	Slate	3 00	River channel	600 feet channel	3,500	....
Stony Bar Company	Kosloski & Co	Gravel	Slate	3 00	River channel	1,000 feet square	4,000	8,000
Buckeye Company	McBride & Co	Gravel	Slate	3 00	150 feet pressure	1,000 feet square	1,300	....

List of mining claims in Gold Run and Dutch Flat mining districts, Placer County, California, on July 1, 1869, reported by E. L. Bradley.

Name.	Owner.	Character.	Gross expenses.	Net profits.	Gross receipts.
Home Ticket..	Bradley, Gardner & Slocum.	Gravel, Hydraulic ..	$2,385 42	$2,088 98	$4,474 40
Deep Shaft....	Bradley & Gardner	Gravel, Hydraulic ..	6,130 59	140 96	6,271 58

Remarks.—Home Ticket, Gold Run district, 42 days' run (water, 300 inches per day) during the past mining season. Deep Shaft, Dutch Flat district, very hard cement gravel; use powder for blasting; works well run; water 85 days, 350 inches per day. Large boulders, claim hard to work; will last six or eight years.

The following letter to my agent in San Francisco gives a fair insight into the difficulties connected with the collection of statistical information on placer mines:

GOLD RUN, *August* 20, 1869.

DEAR SIR: Your letter, with inclosed blanks, duly received.

I had intended to try and comply with your request to fill them out, and requested several of the claim-owners here to furnish me with the figures in regard to their business. They do not appear to be willing to do so, saying that they do not care to let the public know their business.

All I can do is to give you an estimate of the gross yield of the mines, and probably a near estimate of expense. If you desire such information I will give it.

Yours, &c., H. H. BROWN.

W. A. SKIDMORE, Esq.

CHAPTER IX.

NEVADA COUNTY.

This county still takes the lead in mining, and has produced largely again during the last year. Its superiority is due as well to the permanent and more productive character of its mines as to the energy, thrift, and good management of its inhabitants.

Owing to a strike of the miners at Grass Valley and Nevada early in the season, the product of the quartz mines has been somewhat reduced, and the scarcity of water has greatly curtailed the yield of the cement and hydraulic mines. The low stage of water has, however, greatly helped the operations in the river-bed washings, and many miners have done well in this branch.

At Grass Valley nearly all the leading claims have continued their operations successfully, and some of those formerly suspended have been reopened. The most successful new claim is the Idaho, an extension of the Eureka to the east.

The following description of this important mine is from the pen of Mr. W. A. Skidmore, of San Francisco:

The Idaho has but recently assumed a place among our leading mines, and deserves more than a passing notice.

The Idaho mine is a location of 3,100 feet immediately east of and adjoining the Eureka company's ground, being the east extension of that famous ledge, and presenting the same characteristics in width, formation, and character of the quartz. The course of the ledge is northeast and southwest, with a dip to the south of 70°. The location was made in 1863, and the next year a prospecting-shaft was sunk a distance of sixty or seventy feet, which demonstrated the identity of the ledge as the extension of the Eureka. This shaft was then abandoned, but will soon be connected by raising from the first level with the present workings of the mine, thereby securing perfect ventilation in all the levels by means of the ore chutes. The present working-shaft, three hundred feet east of the westerly line of the company's ground, was sunk to a vertical depth of one hundred and fifty feet in 1865, when the ledge was struck, and operations suspended for a year or more; during this time the property passed into stronger hands, and work was resumed by following the course of the ledge to a depth of three hundred feet, and opening levels at one hundred, two hundred, and three hundred feet. The mine was by this means thoroughly opened when the mill was erected in the fall of 1868. During the present year the shaft has been continued to a depth of five hundred feet, and another level opened at four hundred feet. The company are now extracting ore from their west ground, lying between the shaft and the Eureka line, a distance of little more than three hundred feet. The length of their drifts is as follows: 130-foot level, 125 feet west of shaft; 200-foot level, 300 feet; 300-foot level, 306 feet; 400-foot level, 275 feet. These various levels have been connected with wings or ore chutes, and stoping is now in progress, the thorough opening of the mine giving almost unlimited facilities for the extraction of the quartz. The pay zone or "chimney" extends the full length of these drifts in the upper levels. On the 400-foot level a drift has been run east of the shaft one hundred and twenty-five feet, continuing in ore for over one hundred feet, and demonstrating the extension eastwardly of the chimney. As the company have 2,800 feet of unexplored ground in this direction, and all prospecting to the east of their shaft shows the extension of the pay-chimney in this direction with increased depth, it has an important bearing on the future of this promising mine. From the present appearance of the 400-foot level, and the increase of the quartz to the east, it is probable that the 500-foot level when opened will disclose the existence of two hundred feet of ore east of the shaft; making a total length of five hundred feet from the Eureka line, and this may be expected to increase with each succeeding level. It is not the intention of the company to sink the shaft any deeper for a year or more, as the present immense reserves in sight cannot be exhausted in less than two years. The walls of the ledge are well defined, the foot-wall of the east-drift 400-foot level and of other parts of the mine presenting the appearance of a polished slab of marble of variegated colors. The foot-wall is composed of serpentine and the hanging wall of metamorphic rock. The average width of the ledge at the lowest level is three and a half feet, showing a perceptible increase with each successive level. The quartz now in process of extraction will yield as high as $36 per ton, exclusive of sulphurets, which comprise about one per cent.; and this would be a fair valuation on all the quartz in sight in the mine. The shaft is nine by four and a half feet, and is divided into two compartments, one for hoisting and one for pumping. The mine has very little water, but is provided with pumps ample for any contingency. The ore is raised in iron buckets or tubs, as the shaft, being vertical for one hundred and thirty feet, and then inclining 70° south with the ledge, will not permit of the use of the improved cages and cars now put in all first-class mines. These buckets answer very well for hoisting out ore, but it is not much of a temptation for a visitor to make a trip underground in one of them.

The mill of the company is situated within one hundred feet of the hoisting works, from which the ore is run on a tramway and dumped at the battery. There are fifteen stamps of nine hundred and fifty pounds, with a drop of about ten inches, and a velocity of sixty blows per minute, run by a 12-inch engine, 2½-feet stroke. The mill costs, with all the gold-saving apparatus, about $18,000, and is, in all respects, a first-class one; having a crushing capacity of two hundred and ten tons per week of six days. The mill and hoisting machinery consume about twenty-seven cords of wood per week, which costs, delivered, $3 75 per cord. The water is supplied by a ditch, the property of the company, running two hundred inches of water. The system of concentration, amalgamation, &c., is that known as the "Grass Valley system;" and it has here a great degree of perfection after an experience in its use of fifteen years. The process has so often been described in detail as to need but brief mention here. Amalgamation is not practiced in battery, but the quartz is crushed to such a fineness as to permit of its passage through the finest screens, and thence over blankets, which are washed out every fifteen minutes. The results of the blanket-washings are passed through two very simply-constructed amalgamators, where a revolving cylinder, with rakes, stirs the mass in a bed of mercury. The skimmings of the amalgamating boxes are treated in two Knox pans with chemicals, and here thirty-three per cent. of the gross yield is obtained. The pulp from blankets and amalgamators has, meantime, passed through two simple contrivances called "rubbers," where further amalgamation is produced by washing and by grinding cylinders covered with amalgamated copper plates, which are moved horizontally by vibrating arms; thence through sluice-boxes with riffles of mercury to a discharge-box with self-acting gates, which is situated immediately over the concentrating-room. Here commences the separation of the sulphurets, which, still mixed with the sand and water, now flow through a Paine & Stevens concentrator, eighteen feet in diameter. This apparatus is an improvement on the "buddle," used in the tin mines of Cornwall, and seems well adapted to the necessities of mining in California. The sulphurets settle on the outer rim of the buddle, while the sand, water, and such fine particles as have not been caught pass off through the center to the tail-sluice of the mill beyond. As a matter of precaution, the sulphurets are passed through the "buddle." They are then placed in a "tossing-tub," another Cornish appliance; and here a further separation takes place. A stream of water is turned on with the charge in the tub, and a 4-pound hammer striking rapidly and forcibly on the sides of the tub, by its vibrations causes the heavier particles to sink and settle, while the lighter pass off over the edge of the tub to the tail-sluice. The sulphurets are now ready for chlorination. The tail-sluice of the mill has received all the refuse; and still further precautions are used to prevent the escape of any of the precious particles. The sluice, over one hundred feet long, is divided into three sections, one of which is cleaned while the tailings are passing over the other two, where the heavier sands are caught by riffles and submitted to the manipulation of a hooking-trough. Thus the last sulphurets are caught, and the tailings leave the ground of the company.

Receipts of bullion shipped from the Idaho mine, Grass Valley, for six months ending April, 1869.

	Tons.	Amount.
November, 1868	498.65	$8,742 06
December, 1868	1,660.55	29,168 06
January, 1869	1,219.35	21,393 90
February, 1869	1,296.10	22,752 50
March, 1869	985.95	17,243 70
April, 1860	2,354.55	41,673 10
Totals	8,015.15	140,973 32

The bullion receipts for the month of April were swelled by returns of 238 tons of sulphurets, which yielded, by chlorination process, $4,597 52. The receipts for the month of May will exceed $31,000, exclusive of sulphurets.

Net profits of Idaho mine since completion of mill, November, 1868.

Paid for mill and extra improvements	$16,000
Dividend, January, 1869	7,750
Dividend, February, 1869	9,300
Dividend, March, 1869	12,400
Dividend, April, 1869	15,500
Dividend, May, 1869	15,500
Dividend, June, 1869	31,000
Total	107,450

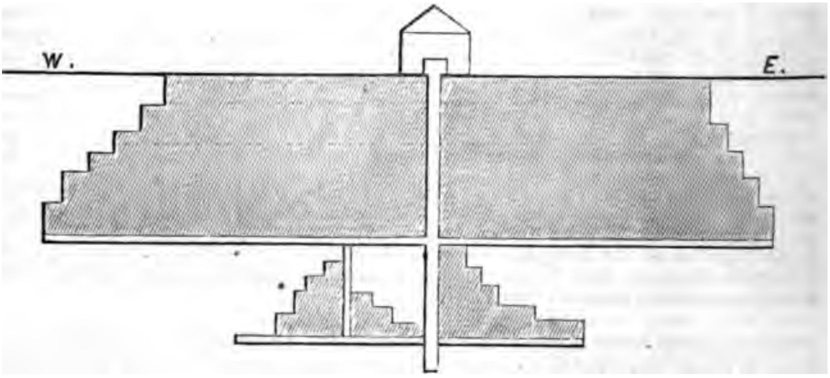
The Idaho mine and mill are owned almost exclusively in Grass Valley, and principally by the following gentlemen: John C. Coleman, Edward Coleman, M. P. O'Conner, Thomas Findley, William Young, Samuel Wittgenstein, and James Dods. Since the incorporation of the company, the mines have been under the superintendence of the Coleman Brothers, who have probably inaugurated more successful mining enterprises than any other men in Grass Valley.

The company have applied for a patent for their claim, and Commissioner Wilson has decided in their favor, against the claim of the Schofield Company, which objected.

The Eureka Company have also obtained a patent from the United States for 23½ acres, covering the Eureka lode for a length of 1,680 feet. In addition to this they have, according to the report of the president, bought 37-40ths of the Roannaise mine, adjoining the Eureka on the west, and comprising 2,000 feet in length on the lode. The company have consequently now 3,680 feet, of which 1,400 only are prospected so far. According to the superintendent's report, 21,526 tons of ore have been raised from the mine during the year; 125 tons were crushed at the Sebastopol mill, and 20,463 tons at the company's mill, in 307½ days, averaging 66½ tons per day with 30 stamps. On the surface were 1,798 tons, the cost of mining and hoisting of which is estimated at $7 per ton, and broken in the mine remained 1,400; estimated cost $6 per ton;

207 tons of sulphurets were saved, 137 of which were worked, leaving 70 still on hand, which are valued at $10,000. 1,085 feet of drifts were driven, and 200 feet of winze and 30½ feet of the main shaft sunk, during the year. The extreme length of the fourth level on October 1 was 1,418, and of the fifth level 640 feet. The fourth level had already produced 37,485 tons of quartz, and was expected to yield 5,000 more. From the fifth level only 1,307 tons had been drawn, and assuming that it would yield as well as the fourth level, it was calculated to contain reserves sufficient to supply the mill for two years. The Roannaise mine was not considered at all in these calculations. The main shaft was down 60 feet below the fifth level. The total proceeds from this mine during the year, from October 1, 1868, to September 30, 1869, were $574,963 99; the cost of the same, $213,752 68; leaving a net profit of $361,211 31, of which amount $264,000 were paid to the stockholders in dividends. The average yield per ton was $27 80, of sulphurets $171 77, and the average cost of mining and milling $9 65 per ton.

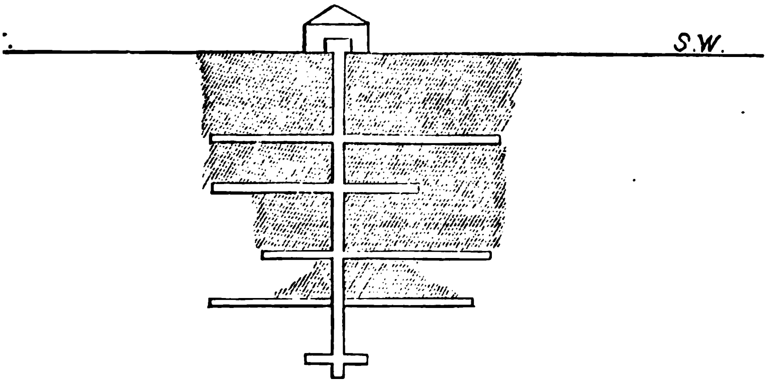
The statistics of the Empire, North Star, and other producing mines, will be found in the annexed tables. The old Allison Ranch mine, which had been lying idle for a long time, has been put in operation again, and at a depth of 486 feet on the incline struck rich ore. The Cariboo, considered a feeder to the main vein, furnishes exceedingly rich ore from a crevice 10 inches wide. The Perrin has forced itself into notice by some very good runs of late; the product for October being $11,200; cost, $2,058. A large amount of rock was taken out faster than it could be milled. The Union Hill and Wisconsin have also attained more prominence, and as these two mines were not described in my last year's report, a short description may here follow.



UNION HILL MINE.—Scale 200 feet to 1 inch.

Depth of incline shaft, 268 feet; to the first level, 160 feet; to the second, 260 feet. Length of first west drift, 400 feet; second, 200 feet. Length of upper east drift, 350 feet; of the lower, 150 feet.

The Union Hill claim 3,000 feet on the Union Hill quartz ledge; average width 3 feet; dip 70° south. The company have removed their hoisting and pumping machinery from their old works to the new shaft, and commenced regular mining operations on January 1, 1869. Their mill contains twenty stamps of 950 pounds each, and the power is furnished by a steam-engine. The yield of the mine from January 1, 1869, to August 1, has been 7,200 tons, which yielded $75,568 92, an average of about $10 50 per ton. The mining and milling expenses during these eight months have been $59,492 09, in which amount $5,000 are in-for a supply of fuel for the coming winter. The accompanying gives all the particulars in reference to the works in the mine.



WISCONSIN GOLD MINE.—Scale 300 feet to 1 inch.

ded parts signify the portions of the mine already worked out, the white ones the reserves. h of incline, 410 feet; length of northeast drifts—first level 180 feet, second 179 feet, third ourth 180 feet, fifth 12 feet. Length of southwest drifts—first level 246 feet, second 111 feet, eet, fourth 200 feet, fifth 10 feet.

Wisconsin Gold Mining Company owns 3,400 feet on the Wis- quartz ledge, near Grass Valley. Dip of vein 27° west. The as been worked quite extensively, as indicated by the accompa- sketch.

368 this mine changed owners, after having been idle for a short In March, 1869, the present owners commenced operations. May had the mine free from water, and a sufficient length of new was run to commence regular stoping. The crushing was done at mills, and continued until July 30. During these three months npany took out 519 tons of quartz, which yielded $17,581 30, 87 per ton. Encouraged by this result, the company concluded ontinue crushing ores at custom mills, and resolved to build their ill adjoining the hoisting works in order to economize in the cost ing the ores and to secure a more perfect treatment. The mill is sist of 8 stamps of 800 pounds each, and will be supplied with all dern contrivances for saving the gold and sulphurets. It will be by steam-power. The average width of the ledge is about 1 foot. following is an extract from the report of J. H. Boalt, mining er, on the Empire Company's property:

hedule C, showing expense of mining and milling at Empire Company's works.

ense of mining and extracting 1,000 tons of ore, being one month's (26 days')

n, $4 per day	$8 00
s, $3 per day	168 00
lers and carmen, $2 50 per day	30 00
ien, $2 75 per day	5 50
and 2 helpers	12 00
abor per day	223 50
6 days' labor	$5,811 00
d cost of proportion of power	260 00
ls of coal at 15 cents	60 00

40 boxes candles, at $4	$160 00
40 kegs powder, at $2 50	100 00
Steel, drills, picks, &c., wear on wire rope, cars, track, &c	250 00
Total for 1,000 tons	6,641 00
Average expense per ton	6 64

b. One month's expense developing 1,000 tons reserve while extracting 1,000 tons ore:

Cost of sinking 100 feet of shaft at highest price	$2,600 00
Cost of drifting 1,200 feet of levels at average price	9,000 00
180 boxes candles, at $4	720 00
180 kegs of powder, at $2 50	450 00
2,400 bushels of coal, at 15 cents	360 00
Proportion of cost of power	1,740 00
Steel, tools, fuse, &c	1,200 00
Contingencies	1,000 00
Total cost of opening 1,200 by 100 feet of vein, averaging 1¼ foot thick, and yielding 12,000 tons ore	17,070 00
One month's (1,000 tons) proportion of above	$1,422 50
Average per ton	1 42

c. One month's expense for pumping:

Proportion of cost of power	$450 00
Sundries	150 00
Total for 1,000 tons	600 00
Average per ton	60

d. One month's expense simple crushing:

4 feeders	$11 00
2 platform men, (Blake's crusher)	5 00
Cost of labor per day	16 00
Cost of labor for 26 days	$416 00
Proportion of cost of power	575 00
Wear and tear of shoes, dies, &c	325 00
Total for 1,000 tons	1,316 00
Average per ton	1 31

e. One month's expense extracting native gold:

6 men for cleaning up	$18 00
Wear of copper plates, melting, &c	30 00
Loss of quicksilver	10 00
Total for 1,000 tons	58 00
Average per ton	.058

f. One month's expense saving and working sulphurets:

2 men to attend concentrators	$6 00
Wear and repair of concentrators	3 00
4 men for pans	12 00
Cost of labor per day	21 00
Cost of labor for 26 days	$546 00
Proportion of cost of power	280 00
Loss in quicksilver	40 00
Wear and tear of castings	30 00

hemicals		$30 00
ontingencies		30 00
Total for 1,000 tons		956 00
Average per ton		956

g. One month's expense for power:

Engines at mine:

ngineers at $3 50 per day		$7 00
ords of wood at $4		16 00
l, &c		3 00
Total per day		26 00
tal for 30 days		$780 00
e-half of chief engineer's salary		75 00
Total		855 00
oportion assigned to mining	$260 00	
oportion assigned to reserve work	145 00	
oportion assigned to pumping	450 00	
		855 00

Engines at mill:

ngineers at $3 50 per day		$7 00
ords of wood at $4		16 00
l, &c		3 00
Total per day		26 00
tal for 30 days		$780 00
e-half engineer's salary		75 00
Total		855 00
oportion assigned to simple crushing	$575 00	
oportion assigned to sulphurets	280 00	
		855 00

RESUMÉ.

ining, per ton	$6 64
ening reserves, per ton	1 42
mping, per ton	60
mple crushing, per ton	1 31
eaning up gold, per ton	.058
ving and working sulphurets, per ton	.956
Total	10 984

ETHOD AND APPARATUS FOR SAVING THE FINEST PARTICLES OF GOLD.

Various experiments have been made, and many different apparatus ere tried, for saving the finest particles of gold, which escape in the ommon stamp-process with the tailings. The following description of method introduced by James T. McDougall is taken from the Grass alley National, and as it appears to have given satisfactory working sults, the account may find a place in this report:

It is well known that the ordinary mill process does not and cannot save all the gold the ore. Probably on an average not to exceed ninety per cent. is saved. Various ntrivances have from time to time been devised to secure the fine particles that go waste. We visited yesterday the works of James T. McDougall, esq., who has patted an invention for securing these infinitesimal atoms of gold. The invention has been in practical use for several months, extracting the precious metal from the was water of the Eureka and Idaho mines, and its utility has been positively demonstrate The contrivance consists of six troughs, each twelve feet by two and a half, inclined a slight angle. The bottom of the troughs or sluice-boxes are covered with copp plates, amalgamated and thickly studded with square iron pegs, about four inches height, and half an inch square. Over these pegs are placed closely-fitting copper ca their outer surface being amalgamated in such a manner that a corner is presented the stream. In other words, the diagonal of the pegs and caps is parallel with t sides of the sluice-box. The waste water from the Eureka and Idaho, from which th have previously extracted all the gold that they possibly could with their blankets, co per plates, rubbers, pans, riffles, buddles, &c., is brought to Mr. McDougall's works, a turned through the troughs we have described. Striking against the pegs, of whi the six troughs contain five thousand, the water boils, and surges, and eddies about, that every atom comes in contact with the amalgamated surfaces. The precipitatio of the gold is greatly increased by the electrical action induced by the difference i latent heat between the different metals, copper, iron, and quicksilver. Amalgam form rapidly, and two men are kept constantly employed in cleaning the copper caps an plates. Owing to the almost microscopical fineness of the gold particles thus save the amalgam obtained does not contain as much gold to the ounce as that ordinaril obtained at the quartz-mills. This is, of course, to be expected. Mr. McDougall ca tell almost instantly what grade of ore is being worked at the mills above him. Whe they are running what they call poor rock, his contrivance saves the most gold; whe they are crushing rich rock, he does not do as well. The explanation is, that thei rock which they call poor may contain as much gold as the rich rock, but it exists i such very fine particles that their mill process cannot arrest it. It is these fine particle that he saves. In their rich rock, their gold being coarser, they save a greater proportion of it.

Return of the production of gold in the Grass Valley mining district, Nevada County, California, for the year ending July 1, 1869, reported by J. F. Nesmith.

Mill.	Owners.	Location.	Mine.	Number of tons of ore.	Average yield.	Total product.	Time of running.	Average number of stamps running.	Whole number of stamps in mill.	Power.	Remarks.
							M'ths.				
Eureka	Eureka Mining Company	Grass Valley	Eureka	21,526	$27 80	$574,963 99	12	30	30		From Oct. 1, 1868, to Sept. 30, 1869.
Empire	Empire Mining Company	Grass Valley	Empire	11,241	31 18	348,673 34	12	30	30	Engine 18 by 42 inches.	
Idaho	Idaho Mining Company	Grass Valley	Idaho	7,043	35 51	250,087 22	10	15	15	12 by 30 inch	Total expenses for 10 months, $97,939 35.
North Star	North Star Gold Mining Company.	Grass Valley	North Star	11,000	30 00	330,000 00	12	24	24		
Union Hill	Union Hill Mining Company	Grass Valley	Union Hill	7,200	10 49	75,568 92	8½	20	20		Since January 1, 1869, expenses since same, $59,492 07.
Wisconsin	Wisconsin Mining Company	Grass Valley	Wisconsin	509	33 87½	17,581 50	4½				Since May 1, to August.
Hartery	E. McLaughlin & Co.	Grass Valley	Hartery	564	34 08	19,439 70	6	8	8		
Perrin's	Joseph Perrin & Co.	Grass Valley	Slate Ledge	810	39 52	32,011 26	12	10	10		
McCauley's	McCauley & Co.	Grass Valley	Ben. Franklin	300	40 00	12,118 00	12		16		Custom mill run only short time on this rock.
Gold Hill	E. Pratt & Co.	Grass Valley	Seven-thirty	110	102 40	11,261 00	7		20		Custom mill run only short time on this rock.
Gold Hill	Buckland & Co.	Grass Valley	Bowery	55	67 24	3,698 00	5		20		Custom mill run only short time on this rock.
Larimer's	Higgins & Larimer	Grass Valley	Higgins	800	26 00	20,800 00	8	10	10		

Exhibit of producing mines in Grass Valley mining district, Nevada County, California, on July 1, 1869, reported by J. F. Nesmith.

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Average value.	Mills.	Product for the year ending July 1, 1869.
					Feet.					
Eureka Mine	Eureka Mining Company...	Quartz..	E. & W.......	78°	1,664	Met. slate and serpentine.	Quartz, iron pyrites, and free gold.	$27 80	Eureka ...	$574,963 99
Empire Mine	Empire Mining Company...	Quartz..	N. W. & S. E..	33°	1,650	Greenstone ...	Quartz, iron pyrites, and free gold.	31 18	Empire ...	348,673 34
North Star Mine...	North Star Gold Mining Company.	Quartz..	E. & W.......	28°	....	Greenstone ...	Quartz, iron pyrites, and free gold.	....	North Star.	....
Idaho Mine	Idaho Mining Company	Quartz..	E. & W.......	65°-78°	3,100	Met. slate and serpentine.	Quartz, iron pyrites, and free gold.	35 51	Idaho	*250,087 21
Wisconsin Mine ...	Wisconsin Mining Company	Quartz..	N. W. & S. E..	40°	3,400	Granite.......	Quartz, iron pyrites, and free gold.	33 87½	Wisconsin.	†17,581 30
Union Hill Mine ...	Union Hill Mining Company	Quartz..	E. & W.......	60°	3,000	Met. slate and serpentine.	Quartz, iron pyrites, and free gold.	10 49	Union Hill.	‡75,568 92
Hartery Mine......	E. McLaughlin & Co........	Quartz..	N. & S........	34°	1,800	Granite.......	Quartz, iron pyrites, and free gold.	34 08	Hartery...	19,439 70
State Lead Mine...	Joseph Perrin & Co.........	Quartz..	N. W. & S. E..	44°	1,600	Greenstone ...	Quartz, iron pyrites, and free gold.	39 52	Perrin's...	32,011 26
Ben. Franklin Mine	M. Casey & Co..............	Quartz..	N. W. & S. E..	38°	1,800	Greenstone ...	Quartz, iron pyrites, and free gold.	40 00	McCauley's	12,118 00

* 10 months. † 4½ months. ‡ 8½ months,

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim, in feet.	Country rock.	Vein matter.	Ore.	Value per ton.
Eureka Mine	Eureka Mining Company	Lode.	E. & W	78°	1,664	Metamorphic slate and serpentine.	Quartz	Iron pyrites and free gold	$27 80
Empire Mine	Empire Mining Company	Lode	N.W. & S. E.	33°	1,650	Greenstone	Quartz	Iron pyrites and free gold	31 18
North Star Mine	North Star Gold Mining Co	Lode	E. & W	28°	3,200	Greenstone	Quartz	Iron pyrites and free gold	
Idaho Mine	Idaho Mining Company	Lode	E. & W	65°-78°	3,100	Metamorphic slate and serpentine.	Quartz	Iron pyrites and free gold	35 51
Union Hill Mine	Union Hill Mining Company	Lode	E. & W	60°	3,000	Metamorphic slate and serpentine.	Quartz	Iron pyrites and free gold	10 49
Wisconsin Mine	Wisconsin Mining Company	Lode	N.W. & S. E.	40°	3,400	Greenstone	Quartz	Iron pyrites and free gold	33 87½
State Lead Mine	Joseph Perrin & Co	Lode	N.W. & S. E.	44°	1,600	Greenstone	Quartz	Iron pyrites and free gold	39 52
Allison Branch Mine	Allison Branch Mining Co	Lode	N. & S	34°	1,600	Granite	Quartz	Iron pyrites and free gold	$23 to 90 00
Hartery Mine	E. McLaughlin & Co	Lode	N. & S	34°	1,800	Granite	Quartz	Iron pyrites and free gold	34 08
Osborn Hill Mine	Osborn Hill Mining Company	Lode	N.W. & S. E	38″	2,000	Greenstone	Quartz	Iron pyrites and free gold	22 20 to 64 30
Betsey Mine	Orleans Mining Company	Lode	N.W. & S. E	38″	700	Greenstone	Quartz	Iron pyrites and free gold	18 00 to 70 00
Stockbridge Mine*	H. Silvester & Co	Lode	N. & S.	25″	2,000	Greenstone	Quartz	Iron pyrites and free gold	60 00
Norambaqua Mine	Forest Spring Mining Company	Lode	N.W. & S. E.	32″	1,800	Greenstone	Quartz	Iron pyrites and free gold	8 00 to 54 00
Lone Jack	Wheeler & Co	Lode	N.W. & S. E.	42″	1,600	Granite	Quartz	Iron pyrites and free gold	15 00 to 80 00
New York Hill Mine	New York Hill Quartz Min. Co	Lode	N.W. & S. E.	34″	1,800	Slate	Quartz	Iron pyrites and free gold	34 00
Gold Hill Mine	Trewella Mining Company	Lode	N.W. & S. E.	32″	1,000	Slate	Quartz	Iron pyrites and free gold	5 00 to 80 00
Higgins Mine	Higgins & Larimer	Lode	N.W. & S. E.	41″	1,600	Slate	Quartz	Iron pyrites and free gold	26 00
Dromedary Mine	Wm. M. Lent	Lode	N.W. & S. E.	36″	1,800	Greenstone	Quartz	Iron pyrites and free gold	6 00 to 65 00
Ione mine	Ione Mining Company	Lode	N.W. & S. E.	31″	1,000	Greenstone	Quartz	Iron pyrites and free gold	12 00
Union Jack Mine	Castle & Co	Lode	N.W. & S. E.	31″	1,600	Greenstone	Quartz	Iron pyrites and free gold	10 50
Ben. Franklin Mine	Casey & Co	Lode	N.W. & S. E.	38″	1,800	Greenstone	Quartz	Iron pyrites and free gold	40 00
Sebastopol Mine	Watt & McCauley	Lode	N.W. & S. E.	38″	1,500	Greenstone	Quartz	Iron pyrites and free gold	25 00
Roannaise Mine	Eureka Mining Company	Lode	E. & W	75″	2,000	Met. slate & serp'ne	Quartz	Iron pyrites and free gold	18 00
Coe Mine	Coe Mining Company	Lode	E. & W	70″	1,000	Met. slate & serp'ne	Quartz	Iron pyrites and free gold	16 00
West Eureka Mine	West Eureka Mining Company	Lode	E. & W	70″	2,000	Met. slate & serp'ne	Quartz	Iron pyrites and free gold	16 00
Wm. Penn Mine	Wm. Penn Mining Company	Lode	N.W. & S. E	60″	1,400	Greenstone	Quartz	Iron pyrites and free gold	12 00

* Being dips and angles of the celebrated Massachusetts Hill Mine.

Estimate of costs of mining and reducing ores in Grass Valley district, Nevada County, California, reported by J. F. Nesmith, July 1, 1869.

Population of district: Six thousand.
Wages of first-class miners: Three dollars per day.
Shovelers and carmen: Two dollars and fifty cents per day.
Wages of surface laborers: Two dollars and fifty cents per day.
Cost of lumber: Eighteen dollars per thousand feet.
Cost of mining timber: Four to twelve cents per running foot.
Cost of common powder: Two dollars and seventy-five cents per keg of twenty-five pounds.
Cost of giant powder: One dollar and twenty five cents per pound.
Cost of quicksilver: Sixty-two and one-half cents per pound.
Cost of freight from San Francisco: Seventeen dollars.
Cost of fuel: Cord wood, four dollars; charcoal, fifteen cents per bushel.
Cost of ten-stamp mill, California pattern, inlcuding freight, erection, &c.: Plan without pans, ten thousand dollars; with pans, thirteen thousand five hundred dollars
Cost of twenty-stamp mill, freight, erection, &c.: About same proportion.

The miners' strike.—During the month of June, 1869, a miners' strik occurred at Grass Valley, the object of which was to prevent the introduction of giant powder as a blasting agent. This strike was peculiarl unjust and uncalled for, and the Miners' League undoubtedly displaye very little good sense in the movement.

In the first place, the Grass Valley mines, being mostly on narrow veins, are burdened with heavy costs of extraction of ore, and the old fashioned system of large double drills and black powder is, under such conditions, peculiarly expensive. In order to get room to swing a sledge, the stopes must be made much wider than the vein, and wider than they would need to be for single drilling. In consequence of the quantity of water in many places, (and invariably in the bottom of the shaft,) a great deal of time is lost in charging and tamping holes with common powder, and the practice of working two men at each hole results in much more idleness than would be the case if the men worked singly; since whenever one of them stops for any cause, the other mus stop also. Finally, the old system of organization gave the mine many opportunities, of which they were not slow to avail themselves, pilfer small specimens of the very rich gold quartz which so frequent occurs in the mines of this district. It is a well-known peculiarity Cornish miners that, although, as a class, sober and well-behaved, (many cases even religious,) they have no conscience concerning t stealing of specimens, and do not consider it wrong to cheat concerni the underground work. They have been educated to believe it to the business of the foreman or mining captain to watch against su peccadilloes, and if he is not sharp enough to catch them, they do n hesitate to overreach him in every way. The mine owners of Gra Valley have suffered especially from the stealing of rich rock by t miners. To break a piece of quartz, however valuable, from a mine an to carry it away without the owner's permission, is not legally theft, bu trespass. *After the rock has been broken* the dishonest removal of an of it from the dump or pile is larceny; but it is generally impossible to get evidence which will satisfy a jury of the latter crime; and even when the evidence is sufficient, a Nevada County jury has never been known to convict; hence the thieving miner has hitherto enjoyed a substantial immunity from punishment. Most of the companies do what they can to prevent loss from this source, by obliging the workmen, on emerging from the mine, to strip off their wet clothes in the "drying-house," and walk naked across the room before putting on their above-ground suits. But in spite of all precautions, the plundering is known to be considerable.

A year ago giant powder was introduced here, and it was soon found to effect a great saving in the mining cost. Single drills, small holes, no waste of time by partners, no delay in blasting wet ground—these were among its mechanical advantages; while the employment of one or two men in each shift for the special duty of firing the blasts and cleaning up the stopes prevented all access on the part of the miners to the newly broken rock, and put an instant end to the whole elaborate system of specimen-stealing, with the necessary attendant system of spying, stripping, and searching. The reduction of the expense of ore extraction amounted in this way to forty, fifty, and even sixty per cent.

The new powder was gradually introduced, and its full advantages, and the revolution in the organization of the shift which it involved, were not at first apparent. It is one thing to use giant powder now and then for single blasts, and quite another thing to organize all the operations underground with reference to its use. So it came to pass that the miners received it at first with favor. Those of them who had taken contracts for drifting or sinking found great profit in its use, and were in some cases allowed to take it freely from the magazines of the mine, as it was thought they would in this way grow familiar with it. After this was forbidden (on account of the high cost of the powder, and the too free use of it by the "contractors,") they begged and stole it whenever they could. At the same time it was employed by the ordinary shift-miners for some eight months without serious complaint. But finally, all on a sudden, the Miners' League demanded its exclusion from the mines, alleging that it was injurious to health, and coupled with this a demand that the distinction between surface laborers and miners underground should be abolished and that these classes of workmen should be paid alike—a thing absurd in itself, and unheard of in Grass Valley hitherto. I need scarcely say that the miners did not ask to have *their* pay *reduced*, for the sake of uniformity, but to have the pay of the laborers *raised*. The secret of this unexpected attitude is the discovery that giant powder, besides cutting off the perquisites of labor, is diminishing the number of miners necessary for a given production, and so far simplifying the labor of these as to require less skill, except on the part of foremen and powder-men. Of course the natural effect would soon be the reopening of a vast number of mines now idle, and an increased demand for really good workmen at high wages as foremen. Only the shiftless, lazy, and ignorant workmen suffer in the end by the progress of the industrial arts, but unfortunately that is the very class which the leagues are too apt to foster and protect. Nothing is more fatal to the true interests of labor than the notion that skill should make no difference in wages. To pay (as the Grass Valley miners demand) the man who pushes a car or loads a wagon above ground the same as one who drills, blasts, or sets timbers underground, is either to underpay the one or to overpay the other; and certainly, at all events, to remove from both the stimulus of ambition and the motive to excellence.

In the strike at Grass Valley, the league was too late. On general grounds, there is not a region in the country where miners have had less reason to complain. Employment has been for many years both steady and well paid. No attempt was made at this time, or talked of, or intended to reduce their wages. Even the murmurs about Chinese labor, which have grown alarmingly bold in many quarters, were not heard in this quiet paradise of employés until provoked by the last folly of those who did not know how to let well-enough alone. And as to the sole plausible reason for a strike—the alleged injurious effects of giant powder—the league was, as I have said, too late.

Is the use of giant powder injurious to health? Certainly not more so, if at all, than it was last year, and for several months of this year, when the miners were anxious to lighten their labor, and increase their profit, *on contract work*, by its employment. Certainly not more so than when they fired their own blasts, instead of having a man to do it for them. It is only, it would seem, when the miners are excluded from the stopes, after the shots are fired, that they find out how terribly noxious (in spite of the *alibi*) are the gases into which they were ready to go without inconvenience to overhaul for rich specimens the freshly broken quartz.

Curiously enough, moreover, it so happens that the giant powder, as now manufactured, is far less likely to be in any way noxious than it was when considered harmless. It is manufactured with greater care, and upon explosion leaves almost no visible smoke. Now, the smoke is all that can reasonably be expected to cause pain or annoyance, as a little consideration will show.

Nitro-glycerine or glonoine has long been a homœopathic remedy for a certain kind of headache, and in larger doses it produces this headache as a pathogenetic effect. Rubbing it upon the skin will have the same effect as swallowing or inhaling it. But after combustion, this organic compound is transformed to inorganic gaseous products which do not possess the same properties; and, in fact, when diluted with air, in a decently ventilated mine, should be no more harmful than the gases of any combustion.

The headache experienced by those who employ nitro-glycerine in any form as an explosive, doubtless arises from the presence in the air, after explosion, of particles of the original substance, not consumed, just as in the smoke of powder we have an evidence of imperfect combustion. The less visible smoke remains, therefore, after a blast of giant powder, the less time will be required for its effects on the air to disappear. Proper adjustment of the charges to secure absolute combustion is a matter bearing directly on the same point. Few mining captains have yet found out how small a charge may be advantageously employed. The almost universal mistake in the use of this explosive is overcharging the holes. (*The useful effect of a blast does not increase in the ratio of the amount of explosive*—least of all when the explosive is a *quick* one.) Even if giant powder gave noxious fumes, the evil could be reduced to a minimum, and would be far less serious than those experienced in quicksilver, arsenic, or even common metallurgical works.

But the general evidence is that, after becoming accustomed to giant powder, no one suffers from it. If there are a few so constituted as to be always affected by it, what of that? Some people are always sick when they ride backward; some when they go to sea; some when they smell camphor. Many soldiers cannot, without injury, attend upon artillery practice. But there will be stages and ships and camphor and cannon for all that.

If the use of giant powder were universally and seriously and unavoidably injurious to health, it might be forbidden by law. But there is no possibility of that prohibition. The facts are all against it. The Chinese used nitro-glycerine (which is chemically the same thing) in the Central Pacific tunnels, and they are not afraid of it. Now, if it is so fatal as the league asserts, why does not the league embrace the opportunity to kill off the Chinese by allowing them to work with it underground? The fact is, giant powder may prove malarious to miners' leagues, but not to miners.

This was part of the great labor struggle in the Pacific Coast—a gle which marks the terminus of the era of mere speculation. For the miners have been begging for the assistance of capital to erect industry into a regular business. Now they have their wish, and st requisite of a business must be complied with: the owners of must be free to work them as they choose, and with what force hoose. If a steam-engine will pump for five dollars where two men bucket cost ten, the engine must be erected. If the cheaper ne is a Chinaman, instead of an engine, why should not the China-e employed?

best men of all parties agreed on many points involved, and the stubbornness of the laborers and miners forced rapidly an agree-on all. The superintendents of the mines, which had been com-to suspend operations, after waiting a few weeks to let the miners ider the position taken by them, finally procured other workmen the more northern counties and had no difficulty whatever in so. Many of the strikers even returned to their work after they at their demands would not be complied with. It is to be ex-l, therefore, that the operations in this leading gold-producing dis-ill not be disturbed again very soon by a similar piece of folly on rt of the workmen.

placer mines.—The letter of Mr. W. A. Skidmore, in my last year's , contains a very full description of the placer mines of Nevada lacer Counties, and it is therefore hardly necessary to enter into a d description again this year.

ve already said that the scarcity of water has prevented regular ions during the last year in these mines: still, a few of them have ed to do quite well under the circumstances. A representative of the class is the one belonging to Judge Brown, at You Bet, a County, and a short description of it will give a very fair idea remaining cement mines in the neighborhood.

cement in this claim lies from eighty to one hundred feet below rface. It is overlain by gravel, which will pay handsomely by lic washing after the cement is removed; the latter is from twelve nty feet thick and quite hard. It is extracted by shafts and tun-nd the timbers in the stopes can be taken out after the cement is ed, so as to allow the superincumbent gravel to cave in, in order pare for washing it off cheaply and expeditiously by hydraulics. oisting and pumping is done by the same water wheel which fur-the power for the stamps. The water to drive this wheel costs per day. Eight hundred and forty tons worked in June yielded 4 28, and a clean-up from one thousand two hundred tons in July result of $17,860 28. The daily cost of working this claim is—

n men, at $3	$48 00
men, at $3 50	10 50
r	9 60
	68 10

linary and extra incidentals make the total expense less than $500 eek. The mine has produced between $500,000 and $600,000 and ospects ahead are good.

mill used on this claim consists of eight stamps of eight hundred ifty pounds each, arranged in two mortars. Lift, twelve inches; ix drops per minute; discharge, five inches above dies; sieves made No. 18 iron with one-eighth inch punched holes; size of sieves,

forty-eight by sixteen inches. Most of the gold is caught by the q
silver in the mortars; the balance by copper plates below.

The American Mining Company, at Sebastopol, in the Junction
district, has done quite well during the last year. A full statemen
their doings will be found in the annexed table.

The Buckeye Hill claims, below Sweetland, have been extensi
worked. This company has bought ground in addition to their
and the average product of their six-weeks' runs has been about $10

They employ six men in their new tunnel, which they own
Sweetland Creek for a length of eighteen hundred feet, and twenty
men at washing. Five hundred inches of water are used.

The Prescott claims, near Omega, have been worked with good re
by W. Kidd & Co. The gold from these claims is very fine, being w
$20 per ounce. One clean-up in September yielded $10,500. In
Kansas ground the existence of a channel has been satisfactorily e
lished, and a San Francisco company proposes to operate here.

My agent for California distributed many sets of blanks among
placer miners of Nevada County, only one of which was retu
partly filled. I am consequently not in a position to give as full st
tics on this branch of mining as I had intended.

Exhibit of producing mines in Junction Bluff mining district, Bridgeport township, N
County, California, on July 1, 1869, reported by Anson B. Sweeny.

Name, American Mining Company, (not incorporated;) owners, J. H. Brown,
Spooner, S. M. Crall, A. B. Sweeny, T. L. Frew, C. H. Ettinger, Moses Davis, James S
L. Gaskill, L. Carmack, J. S. McBride; character, gravel, with cement at the bot
dimensions of claim, one hundred and twenty claims, eighty by one hundred and e
feet each; two thousand feet on the course of channel; it varies from two hundre
fifty to three hundred feet in width; country rock, granite; mills, one, run by a h
gurdy water-wheel; product for the year ending July 1, 1869, $149,000.

Remarks.—The above claims have yielded in five years, up to July 1, 1869, $61
Located in 1852. The prospects ahead are good.

Estimate of costs of mining in Junction Bluff district, Bridgeport township, Nevada C
California, reported by Anson B. Sweeny, July 1, 1869.

Population of district: Twenty-five families—fifty men and fifty-two children.
Wages of first-class miners: Three dollars and fifty cents per day.
Wages of second-class miners: Three dollars per day.
Wages of Chinese laborers: One dollar and seventy-five cents per day.
Cost of lumber: Twenty-two dollars and fifty cents per thousand.
Cost of common powder: Three dollars per keg of twenty-five pounds.
Cost of giant powder: One dollar and twenty-five cents per pound.
Cost of quicksilver: Sixty cents per pound.
Cost of freight from Marysville: One cent per pound.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.:
thousand dollars.

Operations of the American Mining Company.

Common powder used per year, in kegs of 25 pounds	
Pounds of giant powder used per year	
Pounds of quicksilver used	
Pounds of quicksilver lost each year	
Inches of water used daily	
Number of pipes	
Diameter of nozzle, in inches	
Height of bank, in feet	
Pressure of water, in feet	
Cost of water per day	
Number of men employed	
Number of Chinamen	
Average length of runs, in days	
Monthly expenses	$

Length of tunnel, in feet	2,200
Length of tail sluices outside of tunnel, in feet	3,100
Number of under-currents	16
Length of under-currents, in feet	800
Average width of under-currents, in feet	12

Remarks.—We also have tunnels and sluices not mentioned above; we have one started which will be 200 feet deeper than our present ones, and will be about 3,400 feet ong before we reach a shaft to wash through.

CHAPTER X.

SIERRA COUNTY.

The hydraulic mines of this county continue to produce largely, hough it can scarcely claim, as formerly, to lead the State in this branch of mining. Some important progress has been made in quartz mining. Perhaps the most significant event of the year is the formation of a company to exploit the valuable deposits of magnetic iron ore in Gold Valley. This is, I believe, the first enterprise of the kind in California. The deposits occur in the higher parts of Sierra County, and were discovered some years ago. In 1865 they were visited by Richthofen, who writes concerning them: "The deposits, as far as explored, are situated n the headwaters of the North and Middle Forks of the North Yuba River, about twelve miles east-northeast of the city of Downieville, and few miles north of the culminating rocky summit of the Sierra Buttes. The country is mountainous; its waters escape to the west through ravines. Near their sources these ravines expand to basins and valleys, often filled by lakes, and separated from each other by ridges of little elevation above their level. Communication is, therefore, comparatively easy between the different parts of these highlands, as well as with the adjacent eastern valleys, such as Mohawk Valley and Sierra Valley, which, again, are connected by excellent roads with the State of Nevada. The iron deposits are situated along a line about two miles in length, which connects some of the before-mentioned basins—its southerly end starting from Gold Valley on the Middle Fork, while its northerly end extends to a depression on the headwaters of the North Fork, and the central part runs through a gap between both forks. Gold Valley is a fine basin, about 6,200 feet above the level of the sea."

According to a report by Mr. Frank E. Brown, civil engineer, the Gold Valley deposits are oval in shape, two hundred to two hundred and fifty feet in diameter, and presenting an average height above the surface of forty feet by about one hundred and fifty feet in length. Other lodes are said to occur in ten different places, occupying a line of one thousand feet, twelve to seventy-five feet above the ground, and twelve to thirty feet wide. Limestone is abundant and accessible. The San Francisco Bulletin observes, in commenting upon this subject, that there is evidence to show the existence of valuable iron deposits along a line of three hundred miles in the Sierra Nevada, from near the centre to the extreme northern end of the range. In spite of the considerable altitude of the locality referred to, the climate is so mild as to permit the prosecution of work throughout the year. The site selected for metallurgical works is about three miles from Jaimson City, on Eagle Creek, in the Mohawk Valley. It is about forty-seven miles from Truckee, on the Central Pacific railroad, to which point a good wagon road can easily be constructed. This site is recommended also by the abundance of timber and water-power.

The Sierra Buttes mine.—The following account of this mine is taken mainly from an able report by Henry Janin, esq., the well-known mining engineer, of San Francisco:

The Sierra Buttes mine is situated thirteen miles east of Downieville, the county seat of Sierra County. It is approached by a mule trail connecting with Downieville. The Henness Pass wagon road, which connects with the Central Pacific railroad at Emigrant Gap, passes within six miles of these mines. It is under contemplation to connect the mines with this road by a short road some six miles long, the estimated cost of which is $5,000. This will facilitate and cheapen the introduction of machinery and materials. At present heavy pieces of machinery are transported to the ridge above the mines by ox teams, and thence lowered to the mines by block and tackle. These mines are among the earliest worked in California, the records extending back as far as 1815, when the quartz was crushed in arrastras. In 1853 the first stamp mill was erected. In 1857 the mines came into the possession of the present company, and have enjoyed ever since an uninterrupted career of success. The property comprises three veins—the Rose, the Cliff, and the Ariel. They are inclosed in a country rock of hard metamorphic slate. They have a general east and west direction, with a dip to the north of from thirty to forty degrees. The ledges are large, and have been proved over a great length; whenever exposed, the walls are found to be well defined: these and other general features of these ledges combine to assure great permanency in depth. Near the center of the hill in which the veins occur, the three veins converge and concentrate, going west, and become one. The Rose ledge occupies a position south of, and the Ariel (the main ledge) a position between, the Rose and Cliff ledges, of which the latter is found north of both the Rose and Ariel. The workings of these three ledges are connected by cross-cuts from the main working tunnels which are driven in on the Ariel ledge. The ledges, are variable in dimensions. Where the three veins converge, the quartz at times is more than fifty feet thick, while the veins before junction vary from eight to twenty feet. The pay-ore or productive zone of the ledges varies also from two and a half to fifteen feet, and is found sometimes on the foot-wall, sometimes on the hanging-wall, and often, where the vein is large, in the middle, with barren quartz on either side. The Rose ledge is absorbed below the third level by the Ariel, but large reserves of good ore remain in it above that line. Former workings on this vein extended 520 feet in depth, on a shoot of productive ground, 600 feet long, averaging 7½ feet in width of pay ore. The Cliff ledge lies north of the Ariel, and is parallel in dip, but convergent in course. It is worked by cross-cuts from the Ariel, and has two shoots of pay ore, respectively 100 and 60 feet long. It has been worked to a depth of 720 feet. The Ariel is the main ledge, and the most valuable, both by reason of the value of its reserve, and on account of its promise for the future. This vein is worked by a series of tunnels driven in on the vein, and now made 200 feet apart vertically. This system of working, which dispenses with the expense and trouble of shafts, hoisting, and pumping, is made possible by the extraordinary location of the mine—upon a high and steep mountain. The height is some 1,500 feet above the valley of the South Yuba, and the office of the company is 5,100 feet above the sea. The steepness of the mountain is such that no wagon road has been constructed to the mine. The fifth or lowest tunnel is now being driven in, and has already a length of 586 feet. The vein has been worked to a depth of 980 feet. At this depth the first shoots of ore have been cut, proving a length of 221 feet, and an average width of pay matter of two and a half feet, with quartz which will probably yield $17 per ton in the mill. The pay stratum in this shoot occupies the foot-wall portion of the vein of quartz, which will average eight feet in width. The size of the pay streak in this shoot is the same as it was in the fourth level above It is well defined, and has every appearance of permanency. The other shoots of ore, driving west, have all larger veins. The fifth level has still to be continued an additional length of 1,340 feet, to cut under or through the paying ground opened and proved in the third and fourth levels. The fourth level has yet to be driven 840 feet to cut the ore ground proved by the third level above. The greatest length driven into the hill on this vein is by the third level, which has a total length of 1,280 feet.

The paying portions of the vein, in this as in all the gold quartz veins of this State, are represented by shoots or chimneys of productive quartz, with intervals of barren quartz between them. The Ariel ledge has five such shoots of the following lengths, beginning at the mouth of tunnel and going west: 60 feet; 50 feet; 280 feet; 300 feet; 120 feet. The aggregate length on the vein, horizontally, of the productive ground, is therefore 810 feet.

These veins are opened, the water drained off, and the ores extracted entirely by tunnels. There are no draining and pumping shafts or machinery. As the ores come from the various levels, they are let down by an inclined track to the mills, which are situated directly below the fifth level. This necessitates no machinery, as the loaded car going down brings up the empty car. The main levels are 200 feet apart on the incline of the Ariel ledge. They have been opened far in advance of the immediate requirements of the mills, and therefore expose a large amount of pay ore in reserve. The nature of the ground is such that still deeper tunnels may be driven, which will open up sufficient ground to supply the mills, of even a largely increased capacity, for many years to come.

The reserves are estimated as follows:

Cliff ledge,	2,307 tons, with a gross value of	$34,605
Rose ledge,	18,227 tons, with a gross value of	235,187
Ariel ledge,	91,410 tons, with a gross value of	1,040,165
Total....	111,944 tons, with a gross value of	1,309,957

This includes no ground that is not opened on two sides at least. The fourth and fifth levels will undoubtedly cut the shoots exposed above, and open an aggregate of 420 feet on the former and 700 feet on the latter, horizontal length, by 200 feet "backs."

The cost of taking out and reducing this quartz will be less per ton than the present current expenses, as the ground is opened and requires no expenditure for dead-work. The average cost for mining, milling, administration, and improvements, as established by the results of the last eighteen months of work, is $5 94 per ton. Allowing, however, $6 per ton for costs, we reach the following results:

Gross value of reserves	$1,309,957
Cost of extracting and milling, at $6 per ton	671,664
Profit contained in reserves	638,293

Deducting now twenty per cent., or $127,658, for possible over-estimates, we have $510,635, representing the final net profit "in sight" in the serves above the lower levels, and consequently beyond the ordina mining contingencies and uncertainties. These mines have alwa been, and are now, worked with less approximation to their legitima productive capacity than any others of equal note in the State. T extraction of ore (hitherto never more than 45 tons per 24 hours) cou easily be doubled, thus more than doubling the current monthly profi because decreasing in many items the average expense. For reducti the same water-power now employed could be used over and over agai as there is some 900 feet of fall between the present mills and the Yub There are two mills, known as the upper and lower, and situated belo the fifth level on the Ariel ledge. The lower mill has 16 stamps, weig ing each 640 pounds, and driven by a 32-feet overshot water-whe Water is brought from immense reservoirs formed by damming up t lakes some six and a half miles distant from the mines. The supply abundant, (75 inches, miner's measurement,) reliable and constant. T upper mill has 12 stamps, 580 pounds each, with a water-wheel of t same size. The maximum capacity of the two mills, running witho stoppage, is 45 tons per 24 hours. Ninety-two per cent. of this is pr bably about the actual duty. The average yield per ton for eightee months, ending June 1, 1869, was $14 56. The production of bullio for this period was $324,339, and the dividends $192,000, or 58.52 pe cent. of the gross receipts. The net profit per ton was $8 62. The quart tailings from the mills are worked over four or five times in arrastras belonging to other parties, who receive seventy-five per cent. of th yield, under contract with the company. The above estimates includ the gross yield of the arrastras on the credit side, while the proportio repaid to the contractors is included in the expense account. The tota production of the Sierra Buttes Company since 1857 is shown in th following table. Previous to that year the mines are estimated to hav produced about $250,000.

Years.	Yield.	Expenses.	Dividends.
1857	$51, 000	$15, 000	$36, 00
1858	55, 000	15, 000	40, 00
1859	88, 000	20, 000	68, 00
1860	120, 000	37, 000	83, 00
1861	198, 000	48, 000	130, 00
1862	166, 000	54, 000	112, 00
1863	156, 000	57, 000	99, 00
1864	90, 000	75, 000	15, 00
1865	196, 000	64, 000	132, 00
1866	224, 000	70, 000	144, 00
1867	197, 187	89, 000	108, 00
1868	229, 254	91, 254	138, 00
1869	95, 084	41, 084	54, 00
Total	1, 835, 525	676, 338	1, 139, 00

The results for 1869 are brought down only to the first of June. Fro the above it appears that the dividends actually paid out amount t $1,139,000. In addition to these dividends, the mine has paid for all it improvements of every nature from proceeds, and has never levied a assessment.

The ledges in the vicinity of the Buttes have slate on one wall an serpentine on the other, and are reported to range from ten to twenty-fiv feet in thickness. The Chips, the Briggs, and others, are, however, o much smaller dimensions. The Independence, adjoining the Buttes o the west, and situated on the same lode, has been worked during th year with good returns. In both these mines, giant powder and single hand drilling have been introduced, with a reported saving of ten to fifteen per cent. in mining expenses. The Primrose, two miles north of the Buttes, and twelve miles northeast of Downieville, has been worked again, and is reported in promising condition, (see Report of J. Ross Browne, 1868, p. 147.) The works of the Union mine were swept away in the winter of 1868–'9 by a snow-slide, but have been rebuilt. It is now reported that the mine is less troubled with water than formerly, and that the ore can be extracted and milled for $7 per ton. The Alaska mine, near Pike City, is reported to have struck very rich rock. The sulphuret tailings assay $380 per ton, and the quartz (soft and decomposed) assays from $12 to $200, from the surface down. The small five-stamp mill of the company has extracted $13,000 from 350 tons. The Bush Creek mine yielded during the year ending September 18, 1869, 3,380 tons of quartz, from which $105,805 was extracted, or $31 31 per ton. The product of December, 1869, is reported at $27,500, of which $7,000 covers mining and milling expenses. The average yield of the quartz for December was $42 50 per ton. This vein is six feet thick, and has been opened to the depth of 300 feet. The mill has twenty stamps, two Knox pans and a Payne and Stevens buddle, all driven by a 50 horse-power steam-engine.

In August, 1869, a piece of gold, weighing 95½ pounds, was taken from the Monumental mine in this county. Its original weight, indeed, is declared to have been 140 pounds, but a piece is said to have "become detached." Some $70,000 have been extracted from this mine during the short time it has been in operation. About the same time, and not far from the same place, a company of Chinamen picked up a nugget worth $1,800. The Monumental nugget is remarkable, not only by reason of its size, but because it was taken from a quartz claim, instead of an alluvial deposit. If the statements in relation to the nugget be correct, it is the largest piece of gold yet found in a vein, so far as I am informed; and its discovery tends to throw discredit on the theory (which is nevertheless gaining ground, and which, as I take occasion elsewhere in this report to show, is not unreasonable) that vein-gold becomes refined and aggregated after its accumulation in placers.

The annexed account in relation to the great nugget is considered entirely reliable.

> We take pleasure in giving the following particulars about the great California nugget:
>
> This, the largest piece of gold ever found in California, was taken out from the Monumental quartz mine, situated about twelve miles north of Downieville, at the Sierra Buttes. It weighs 1,142.25 ounces, or 95½ pounds, as cleaned, and is almost pure gold, being valued at $21,156 52.
>
> The Monumental quartz mine is owned by Messrs. Wm. A. Farrish & Co., and located upon the same mountain as the Sierra Buttes and Independence mines. The country has been used heretofore as an extensive and rich quartz district.
>
> Work was begun on the mine about the 1st of last July, by sinking upon the vein a narrow ledge, varying in width from twelve to forty-eight inches, and filled with decomposed quartz. It paid from the surface. The nugget was found at a depth of twenty-five feet from the top, on the 18th of August.
>
> There has been taken from the mine, up to the 1st instant, $70,000, with the labor of three men, and it is still paying at the rate of $1,500 per day, the gold being washed from the decomposed quartz with common pans.
>
> A. T. FARRISH & CO.
>
> SAN FRANCISCO, *September* 2, 1869.

In connection with this county, an article by John S. Hittell, in the Overland Monthly for November, 1868, on the "Dead Rivers of California," possesses much interest. I quote a large part of it:

> A dead river is a channel formerly occupied by a running stream, but now filled up with earthy or rocky matter, and is not to be confounded with a channel that is open

and remains dry during the greater part of the year because of a lack of water, or that has been abandoned by the stream for a deeper channel elsewhere. A dry river bed is not a dead river.

The dead rivers of California, so far as known, are on the western slopes of the Sierra Nevada, from five hundred to seven thousand feet above the sea. They are all auriferous and therefore they have been sought for and examined. They have yielded probably $300,000,000 in all; they now produce perhaps $8,000,000 annually. They are not less interesting therefore to the miner than to the geologist, not less important to the statesman than to the antiquarian.

The largest dead river is known as "the Big Blue Lead," and has been traced from Little Grizzly, about latitude thirty-nine degrees, forty-five minutes, in Sierra County, to Forest Hill, about latitude thirty-eight degrees, fifty-five minutes, in Placer County, a distance of sixty-five miles. The course is south-southeast, the position about thirty miles west of, and parallel with, the main divide of the Sierra Nevada. The elevation is five thousand feet above the sea at Little Grizzly, and twenty-eight hundred at Forest Hill, showing an average fall of thirty-three feet per mile. The live rivers of the Sierra Nevada run at right angles to the course of the range, and have cut cañons from fifteen hundred to three thousand feet deep, and they are separated by ridges which are from three to six miles apart, and are as high as the cañons are deep. The Blue Lead runs across these ridges from two hundred to one thousand feet below their summits. The traveler does not see any signs of a dead river in these ridges, which are as high and have the same general appearance at the Blue Lead as at other places. I shall presently tell how the miner discovers the lead, but before coming to that I want to give you a clear idea how the dead river crosses the ridges. Take a piece of common ruled cap paper; put your pen on a line, draw it up at an angle of forty-five degrees to the second line above, then down to first line at the same angle, and so on until the line made by your pen looks like eight rectangular saw teeth, which are about an inch high. Consider those teeth as the ridges of the Sierra Nevada on the line of the Blue Lead in Sierra County, and the intervals between them as the cañons. Write over the first cañon to the left, Cañon Creek; over the next Goodyear's Creek; and over the others consecutively, North Fork of the Yuba River, Rock Creek, Oregon Ravine, Wet Ravine, and Middle Yuba. Now draw a horizontal line across all the ridges a quarter of an inch from their tops. That line is the Blue Lead. The diagram, made as directed, represents a perpendicular section of the ridges and cañons of the Sierra Nevada, on the line of the Big Blue Lead in Sierra County, as seen from the west.

I have said that the traveler would see no sign of a dead river in riding over the country. The ridges are as high on its line as elsewhere; the cañon sides present the same appearance. Years elapsed before the miners discovered the existence of the ancient channel. But it required only a few months for the discovery that the live rivers were very rich in gold up to a certain point; that the abundance and size of the particles increased as they ascended up to that point; and that beyond or east of that point the streams were poor. Those points on the different streams were nearly in a line. Just there the ravines on the sides of the cañons were very rich, and they were comparatively poor elsewhere. The miners followed up the ravines, washing the dirt in their beds, and the dirt where the ravines were not too steep was a foot or two deep over the slate rock. At last, when the miners got near the top of the ridge, they found that the narrow, shallow rock-bed of the ravine suddenly disappeared, and the body of the hill was composed of gravel, which had a peculiar blue color, and part of it, a horizontal stratum about half a mile wide from east to west, and five feet thick, was very rich in gold. They looked after the metal and paid little attention to anything else. As the stratum ran across the ridges from north to south, the miners followed it in with adits or tunnels, and in more than one place the tunnels met; and a few years ago it was customary for footmen passing between Monticello and Excelsior to go under ground a distance of a mile rather than to climb over the hill six hundred feet high, by a path nearly two miles long. In the same manner Forest City and Alleghany were connected by a continuous tunnel; but the timbers have rotted, the roof has fallen in, and the passage is now closed.

The auriferous deposit is gravel, mixed with boulders, clay and sand, varying from a hundred to three hundred feet in depth; in strata distinguished from one another by differences in color, in the size of the boulders and gravel, and in the number and size of the particles of gold. The predominant color is bluish-gray, dark at the bottom and lighter above, with a reddish tinge in those places that have long been exposed to the air, showing the presence of iron. The material of the boulders, gravel, and sand is almost exclusively quartz. In the whole length of the river, as traced for a distance of sixty-five miles, assuming that the deposits of gravel average half a mile wide and two hundred feet deep, there were, counting in the portions which have been washed away by the live rivers, six billion six hundred and sixty million cubic yards of quartz and clay, and the quartz alone must have measured five billion cubic yards. In the live rivers quartz forms only a small portion of the gravel.

Whence came all the quartz of the Big Blue? How did it happen that no granite, slate, porphyry, basalt, or sandstone was buried in its bed? If all the quartz veins now known in California were cleaned out to a depth of one hundred feet, they would not supply so much as is found in sixty-five miles of a river that must have run for many hundreds of miles. The gravel is all water-worn, and rounded by long attrition. It came from far north. A piece of rough quartz, while being carried five hundred miles in the fiercest of our mountain streams, would not be worn so smooth as is every pebble in the Blue Lead. And the immense size of the boulders implies a mighty current. Those in the lowest stratum average, in some places, a ton, and many are found of twenty tons. These are worn as smooth as the pebbles. They are not found scattered here and there as though they had tumbled down from the banks of the river near the spot where they are found; but they are evenly distributed in a stratum of equal thickness across the whole bed, and for miles in length. Above that may be a stratum of boulders of half the size, and then another stratum of larger ones. The great river handled these masses of rock with as much apparent ease, and spread them out as evenly, as if they had been no larger than pigeons' eggs.

The particles of gold are larger in size, and contain more silver at the bottom than at the top. The smaller pieces are in the upper strata, and as they have a larger surface proportionately, the silver is eaten out by the sulphurous acid which is developed in the gravel by the oxidation of pyrites. If a double eagle and twenty one-dollar pieces are thrown into a solution of vitriol, and left there for several weeks, the small pieces will, at the end of that time, contain a larger proportion of gold than the large one; and for a similar reason the surface placer gold is finer chemically than that obtained from the deeper strata. As a general rule, the deep gold is nine hundred fine, or is worth eighteen dollars and sixty cents per ounce, and the surface gold is nine hundred and twenty fine, and is worth nineteen dollars per ounce in the Big Blue Lead. The gold and gravel are deposited as in live rivers. There are banks, bars, eddies, ripples, rapids, and falls. There is little gold in the rapids, and much in the eddies. The richest places have contained as much as fifty dollars to the cubic yard of the lower stratum, or if the large boulders were left out of the estimate, to two or three cubic feet. The space between the boulders is filled with sand, clay, and gravel, which contains the gold. In the upper strata there are from fifty cents to two dollars to the cubic yard. The bed is of slate rock, and the banks are from fifty to three hundred feet high; but there are few places where they have been examined, for nowhere has all the gravel been washed away across the channel.

But how was it possible that the bed of a large river could be filled three hundred feet deep with gravel? When the miners in 1850, 1851, and 1852, flumed the live rivers of California, and took the gold from their beds, they found a deposit of gravel that did not average more than five feet deep on the bed rock, in streams that ran in cañons one thousand feet deep; and it is strange that the Big Blue should have filled its bed with gravel. Yet this filling up is not without an analogue in our day. Under the influence of hydraulic washing, Bear River and Yuba River have, within the last fifteen years, begun to fill up with gravel, and their beds have, for miles, risen seventy feet or more above the levels of 1853. This gravel is auriferous, and it is deposited in strata, and the arrangement and general appearance resemble those of the Big Blue Lead. The filling up began down in the valley, and as it ascended the current became less rapid and lost the power to carry away the gravel. In Bear River, below Dutch Flat, the bed rises two feet per month during the chief washing season, from February to September, and in the remaining four months it falls on account of the stoppage of washing and of the winter floods which carry away perhaps half of the accumulation of the summer.

Some persons claim that various camps on parts of dead rivers in Plumas County are on the Big Blue Lead, and others think that portions of a dead river, near Placerville, belong to the same stream. I do not accept these theories, but if they are true, the Big Blue River has been traced about one hundred and ten miles. In the northern part of Plumas County the river is buried under deep beds of lava and basalt, and south of Placerville it is probably below the level of the live streams, and thus cannot be found by any system of mining or mode of prospecting now in use. Even in places where it is above the level of the live streams it may be covered on the sides of the cañons by slides of rock or of barren dirt or gravel, and the miner might spend thousands of dollars in a vain search for treasures not ten feet from his drift, as many have done, and some accident, luck, or perseverance afterwards proved the proximity of the rich deposit. In several cases the lead was found by calculation. The miner took his position on a hillside, on a line and on a level with other mining camps, and in a few days he found a fortune; and others have spent years working on a similar plan without success. The river must have taken bends on the north side of Rock Creek and Oregon Ravine, and twelve years of searching have not revealed the position of the bends.

But why did the Big Blue River die, and leave nothing but its gravel and its gold to tell the story of its existence and of its greatness? The main cause must have been the subsequent rise of the Sierra Nevada. Suppose that a range of mountain, sev thousand feet high, were upheaved thirty miles east of the Mississippi; that the b of that stream were on the mountain side three thousand feet above the sea, and tl thirty miles west the country retained its present level; the result would be that the pr ent Mississippi would soon be a dead river; it would be cut across by streams runni down the mountain side, and pouring into a new Mississippi, thirty miles or more w of the present one. We know that the Sierra Nevada has been upheaved; that a lar stream ran on what is now the mountain side, and that it has been succeeded by a n river farther west; and we must infer that the death of the old and the birth of t new river were caused by the upheaval.

Many of the hills crossed by the Big Blue are capped with lava or basalt, which co ered much of the country from near the summit of the range to about three thousand fe above the sea. It seems then that the river filled its bed with gravel; the mountai began to rise, and volcanoes broke out along the divide; the lava ran down and co ered the land to the line of the dead river and beyond it; the mountains rose st higher, and the waters running down their sides cut through the lava and made de cañons, and washed away two-thirds or three-fourths of the dead river, and scatter its gold among the living waters.

The descent of thirty-three feet per mile observed between Little Grizzly and Fore Hill would make a terrific current in a stream half a mile wide. The Sacramento is lively river, yet its grade is only five feet in a mile. But no ordinary current coul have carried the large quartz boulders of the Big Blue Lead from distant regions, an distributed them evenly over the river bed. It is possible, however, that in the liftin up of the mountains the relative elevations have been altered, and that the presen grade differs from that of the Big Blue while it was alive.

A question suggests itself whether the great dead river was the predecessor of an live stream; but to this no satisfactory answer can now be given; and it is doubtfu whether time and research will ever furnish one. The Big Blue was parallel to th Sacramento, and has, to a certain extent, been succeeded by it; but it drained a muc larger district than the Sacramento does, or the rain-fall of the country was muc greater in the era of its existence. The Sacramento does not carry one-fourth of th water which ran in the Big Blue—probably not one-tenth. If we could ascertain tha the quantity of rain had not altered, then we would be justified in presuming tha the Columbia River, which would about fill the bed of the Big Blue, instead of turnin westward at Walla-Walla, originally continued southward, until the lifting up c Shasta and Lassen, and the adjacent ridges, stopped its course, and compelled it t break through the Cascade Range at the Dalles. With our present limited knowledg we are not justified in calling the Big Blue River either the Dead Sacramento or th Dead Columbia.

Some persons have argued that the Big Blue Lead never was a river, but only lacustrine or alluvial deposit. This theory, however, is untenable. The Big Blu Lead has all the marks which a dead river should have. It has a long course, a widt nearly uniform, a course nearly straight, some bends with eddies on the inner side, peculiar quartz unlike any found in the neighboring ridges, or in the streams to th eastward, and abundance of quartz which no place now known to us could have sup plied, and which came probably from a distant northern region now covered with lava water-worn gravel, which must have been carried far; flat stones pointing dow stream, as a current would place them; strata of coarse and fine gravel, which mus have been deposited in a stream; a uniform descending grade; the coarse particles o gold which could not have been distributed so evenly over a wide channel except in strong current; an immense quantity of gold, which required ages to scatter through a deposit three hundred feet deep; driftwood unmistakably water-worn; trunks o trees with the butts up stream; tributary brooks, and a number of other evidence which would require more space for their description and explanation than I coul spare. To say that the Big Blue is not a dead river is equivalent to saying that th bones of the mastodon never belonged to a living animal, but were formed under geo logical influences exclusively.

If this were the only dead river in the State, the proof would be less conclusive, bu there are a dozen others. One which runs southwestwardly, and may be called th Dead Brandy River, appears at La Porte, Brandy City, Camptonville, and North Sa Juan, and is marked by the same general characteristics, save that the gravel is fine the pebbles in the upper strata being generally not larger than a pigeon's egg.

In Tuolumne and Calaveras counties we have the Dead Stanislaus or Tuolumn Table Mountain, which runs from near Silver Mountain, in Alpine, to Knight's Ferr and there disappears. It is covered by a bed of basalt, which flowed as lava from volcano and filled up the ancient bed; and this basalt has resisted the wear of th elements, and now stands as a mountain forty miles long, a quarter of a mile wide, a eight hundred feet high, the softer adjacent slate rock having been wasted and wash away. Under this mountain lies a dead river rich in gold. A similar table mounta of basalt, covering an auriferous dead river, which I call the Dead Cherokee, after chief mining camp, extends seventy miles from Lassen's Peak to Oroville. At Bangor, in Butte County, is a small, dead river, seventy feet below the general surface of the ground, and covered with ordinary soil and gravel. There are also dead rivers at Smartsville, Mokelumne Hill, and San Andreas. The Big Blue and the Dead Brandy are distinguished by the depth of their gravel and by the absence of pebbles of eruptive origin in it; the others have either short courses or shallow deposits of gravel; and the quartz forms a much smaller percentage of the gravel. In the dead rivers at Cherokee, Bangor, and Smartsville, a large proportion of the boulders and pebbles is of lava and basalt, as if the streams had been formed after the commencement of the volcanic era. But different as is the material of the gravel, the fluvial origin of the deposits is similar and indubitable in all of them, when they are studied together.

Estimate of costs of mining and reducing ores in Sierra County, California, reported by E. Spaulding, July 1, 1869.

Wages of first-class miners: Four dollars per day.
Wages of second-class miners: Three dollars per day.
Wages of surface laborers: Two dollars and fifty cents per day.
Cost of lumber: Twenty-five to thirty dollars per thousand feet.
Cost of mining timber: Five dollars per cord.
Cost of common powder: Three dollars per keg.
Cost of giant powder: One dollar and fifty cents per pound.
Cost of quicksilver: Ninety cents per pound.
Cost of freight from Marysville: One and a half cent per pound.
Cost of fuel: Four dollars per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Ten thousand to twelve thousand dollars.
Minimum mining cost per ton of ore: Seven dollars.
  Mine from which this is reported: Brush Creek.
  Character of rock at that mine: Talc slate.
  Depth of mine: Two hundred and fifty feet.
Maximum mining cost per ton: Nine dollars.
  Mine from which this is reported: Alaska.
  Character of rock, &c.: Talc slate.
  Depth of mine: Two hundred feet.
Minimum reduction cost: Five dollars.
Character of process employed: Common mill process.

Return of the production of gold and silver in Sierra County, California, for the year ending July 1, 1869, reported by E. Spaulding.

Mill.	Owners.	Location.	Mine.	Average yield.	Time of running.	Average number of stamps running.	Power.
Brush Creek	N. A. Watson & Co	Brush Creek	Brush Creek	$41 47	1 year	10	Steam.
Pike City	Pike City Gold Mining Company	Pike City		32 00	1 year	5	Steam.
Newell's Mill	Governor Newell	Alleghany		5 00	4 years	10	Steam.
Oriental	Moyle & Co	Wet Ravine	Oriental	(*)	5 years	8	Steam.
Docile	F. Smith & Co	Kanaka Creek	Docile	12 00	2 years	10	Water.
Ironsides	Kontz & Co	Nebraska	Ironsides	7 00	6 months	10	Steam.
Churcole	Langton & Co	Churcole Ravine	Churcole	5 00	7 months	8	Water.
Keystone	H. Scammon & Co	Keystone Ravine	Keystone	30 00	7 years	12	Steam.
Chips	Chips Gold Mining Company	South Fork North Yuba	Chips	4 00	6 months	4	Water.
Buttes	Reese & Co	Sierra Buttes	Buttes	14 16	13 years	24	Water.
Independence	Wood & Co	Sierra Buttes	Independence	10 00	12 years	24	Water.
Kanaka		South Fork North Yuba	Kanaka		2 years	20	
Gold Bluff		South Fork North Yuba				12	
Oak Flat	Stevens & Co	Alleghany	Kanaka Creek	10 00	1 month	8	Water.

(*) Pocket lode, all quartz, containing rich sulphurets.

List of mills in Sierra County, California, on July 1, 1869, reported by E. Spaulding.

Name of mill.	Location.	Kind of power, water or steam.	Horse-power of engine.	No. of stamps.	Weight of stamp.	No. of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	No. and kind of pans.	Cost of mill.	Crushing capacity per day.	Size of screen.	Height of screen above die.	Amount of wood consumed per day.	Cost of treatment, per ton.
							In.	*In.*	*In.*			*Tons.*		*In.*	*Cords.*	
Brush Creek	Mountain House	Steam	40	10	700	62	8½	10	9	2 Wheeler	$25,000	12	No. 3	12	4	$12 00
Independence	Wolf Creek	Water		8	700	60	8	10	9		6,600	6				10 00
Alaska	Pike City	Steam	15	5	700	60	8½	10	9		6,500	4½			⅞	12 00
Docile	Kanaka Creek	Water	15	10	750	85	7½	10	9		11,000	24	No. 4	14		5 00

CHAPTER XI.

YUBA COUNTY.

The following letter from Lyman Orsley gives full particulars in relation to the placer mines in the neighborhood of Smartsville, Yuba County:

SMARTSVILLE, YUBA COUNTY, CAL.,
August 29, 1869.

DEAR SIR: The postmaster at this place has handed me your circular letter of July 24, together with tables for statistics of the mining operations of this vicinity. This being entirely a gravel or hydraulic mining district, I prefer giving you the information desired in the shape of the following general remarks.

The work now being prosecuted is merely washing off the upper or top strata to a depth, in many places, of one hundred and forty feet. This brings the miners down to the upper strata of the ancient river bed, which follows an easterly and westerly course, under a range of hills, which has to be washed down preparatory to working the old channel. This ancient river bed is very rich, as proved by the Blue Gravel Company, which is the only company who have worked it so far. The country here is in the hands of some six incorporated companies, four of which are running bed-rock tunnels at great expense, to strike the old channel on the bed rock. The first of these companies to which I refer is the Pactolas Gold Mining Company. This company are now washing off the upper strata, taking out, when running, from $250 to $400 per day; they wash about one-third of the year. Value of mine, $150,000. The company are running a bed-rock tunnel to strike the old river channel. The gravel bank being washed at present is 150 feet high. The new tunnel will give them 180 feet in addition; length of tunnel 800 feet, 600 of which are completed. The rock being very hard, it will require eighteen months to complete the work. Cost, $40,000. Area of mining ground, 1,000 feet on old channel, embracing some 40 acres of gravel land.

Next is the Pittsburg Mining Company. They are also running a bed-rock tunnel, 1,600 feet in length; area of mining ground, 2,400 feet on old channel. Present product of mine, $600 per day while washing. This is from the upper strata. The cost of this tunnel is estimated at $140,000.

Adjoining the Pittsburg on the east is the celebrated Blue Gravel. This mine has opened the old river channel some four years ago; since which time the product has been a million and a quarter, and it is still paying well. Area of this mine on channel 1,200 feet, with adjoining mining lands, comprising some 80 acres of gravel mining land. The company's present tunnel will not permit them to work within 40 feet of the bottom of the old river bed. They are running a second tunnel, which brings them about 60 feet deeper. This will enable them to work out the ancient river bed clean. It will be completed in two years at a cost of some $90,000. The annual product of the Blue Gravel is near $275,000.

East and adjoining the Blue Gravel are the mines and works of the Nevada Reservoir Ditch Company, a corporation, the stock of which is held in Boston and Providence. The mining territory belonging to this company comprises over 100 acres. The upper strata are being worked down to the surface of the old river bed, paying as much as $400 per day while washing. The company are running a bed-rock tunnel, which will tap the old river 110 feet deeper than the present workings. This tunnel will be 2,372 feet in length, and is driven from the mouth and from two shafts. Giant powder and single hand drills are used exclusively, and found to effect a saving of at least thirty per cent. compared with common black powder, and the large drill. This tunnel will be completed in one year, and will cost about $140,000. From the known richness of the mine the owners feel confident of being reimbursed in six months after the completion of the tunnel.

There is also the Smartsville Hydraulic Mining Company. This company have some 100 acres of mining land. They are also working off the upper strata, which are not very rich. But the company have more than a mile of 4-foot flume, through which the gravel and cement are passed. The facilities of working are of the most perfect kind, the work being done with powder and water as far as possible. Twelve hundred and one kegs of powder have been exploded in a single blast. The company have made but one clean up, which yielded over $30,000. This will be surpassed by the present washing.

Estimate of cost of mining and reducing ores in Brown's Valley district, Yuba County, California, reported by John Nisbet, July 1, 1869.

Population of district: Two hundred and fifty.
Wages of first-class miners: Three dollars per day.

Wages of second-class miners: Three dollars per day.
Wages of surface laborers: Three dollars per day.
Cost of lumber: Twenty-five dollars per thousand feet.
Cost of mining timber: Twelve and a half cents per foot.
Cost of common powder: Three dollars and fifty cents per keg.
Cost of giant powder: One dollar and twenty-five cents per pound.
Cost of quicksilver: Sixty-two and a half cents per pound.
Cost of freight from Marysville: Forty cents per one hundred pounds.
Cost of fuel: Three dollars and fifty cents per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Ten thousand dollars.
Cost of twenty-stamp mill, freight, erection, &c.: Twenty thousand dollars.
Minimum mining cost per ton of ore: Four dollars per ton.
  Mine from which this is reported: Pennsylvania mine.
  Character of rock at that mine: Variable.
  Depth of mine: About seven hundred feet.
  Minimum reduction cost: Two dollars per ton.
  Name of mill, and number of stamps: Pennsylvania mill; sixteen stamps.
  Character of process employed: Copper plates, Chilian mill, and pan.
Maximum milling cost: Three dollars per ton.
Average mining cost per ton: Five dollars per ton.
Average milling cost per ton: Two dollars and fifty cents per ton.
Average yield of ore: Fifteen dollars per ton.

Remarks.—As I have been but a short time in the district, the above must be taken as only approximately correct.

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Mills.
Pennsylvania	Pennsylvania Company	Lode	N. and S	45° to 60°	3,000 feet	Soft schist	Quartz	1
Sweet Vengeance	Sweet Vengeance Company	Lode	N. and S	Vertical.			Quartz	1
Rattlesnake	Rattlesnake Company	Lode	E. and W	45° to 60°			Quartz	1
Donnebroche	Donnebroche Company	Lode	E. and W	45° to 60°			Quartz	1

List of mills in Brown's Valley mining district, Yuba County, California, on July 1, 1869, reported by John Nisbet.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Horse-power of engine.	No. of stamps.	Weight of stamp.	No. of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	No. and kind of pans.	Cost of mill.	Crushing capacity per day.	Size of screen.	Height of screen above die.	Amount of wood consumed per day.	Cost of treatment per ton.
								In.	*In.*	*In.*			*Tons.*		*In.*	*Cords.*	
Pennsylvania Mill	Pennsylvania Company	Brown's Valley	Steam	80	16	650	70	10	8	8	1	$25,000	24	42 by 16	5	6	$2 50
Donnebroge Mill	Rideout & Smith	Brown's Valley	Steam	25	8	720	70	10	8	8	....	12,000	12	42 by 16	5	3	2 50
Rattlesnake Mill	Sherrif	Brown's Valley	Steam	35	10	650	70	10	8	8	....	10,000	15	42 by 16	5	3	2 50
Sweet Vengeance Mill	Sweet Vengeance Company	Brown's Valley	Steam	60	10	650	70	10	8	8	1	30,000	15	42 by 16	5	4	2 50
Scabby Hill Mill	Gaskin & Co	Scabby Hill	Steam	12	4	600	70	10	8	8	....	5,000	6	42 by 16	5	1½	2 50

Remarks.—The above is rather a rough estimate.

CHAPTER XII.

BUTTE COUNTY.

The following letter from John Nisbet, esq., superintendent Nisbet Mining Company, together with the subjoined tables, furnis the quartz-mining items of importance in the above county. The sent out to the hydraulic mines at Cherokee Flat and Morni have not been returned filled. The idea of giving information their doings to the public seems to be particularly obnoxious gravel and hydraulic claim-owners.

OREGON CITY, *August* 24,

DEAR SIR: Inclosed please find two blanks filled as required. The informa quested in Nos. 1 and 2 can best be given in a few general remarks.

The Oregon Gulch district is about eight miles long by two in width. It is se from the Sacramento Valley by the table-land lying a few miles north of Orovi

All the known gold-bearing veins, with one single exception, strike very nearl and south, dip from 45° to 60°, and vary in thickness from one to ten feet. T inclosed in a soft, decomposed rock, which resembles in appearance the trap generally scattered over the foot-hills, and which hardens at a depth of from one hundred feet from the surface.

The greatest drawback in working this class of veins is the irregularity yield. The ore being at one time rich, at another nearly barren, the lack of s means usually brings mining to a stand-still whenever a poor place is met wit hard rock.

During the year ending July 1, 1869, no steam mills have been running in trict, while the water mills have not reduced more than fifty or sixty tons per which probably yielded $10 or $12 per ton.

The exceptional case mentioned above is the Oroville lode, at the south end table-land, near Feather River. This vein courses east and west, and stands vertical. It is distinctly separated from the country rock by a narrow strip clay slate, and has a more uniform character and yield than the other veins. not been worked during the past year, being in litigation, and will probably lie idle during the coming year.

The prospects for the immediate future are not encouraging, although several among them the Cambria, are about to resume operations. The mine-owners ha far only met with disappointment and loss in a majority of cases, the hired m ting most of the money taken out. If the price of labor could be reduced, and more equitable division of the proceeds of mines brought about, this district undoubtedly yield largely in the future.

Estimate of costs of mining and reducing ores in Oregon Gulch district, Butte Coun ifornia, reported by John Nisbet, July 1, 1869.

Population of district: About six hundred.
Wages of first-class miners: Three dollars per day.
Wages of second-class miners: Two dollars and fifty cents per day.
Wages of surface laborers: Two dollars and fifty cents per day.
Cost of lumber: Twenty-five dollars per thousand feet.
Cost of mining timber: Ten cents per running foot.
Cost of common powder: Ten per cent. on San Francisco price.
Cost of giant powder: One dollar and twenty-five cents per pound.
Cost of quicksilver: Ten per cent. on San Francisco price.
Cost of fuel: Three dollars and fifty cents per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Te sand dollars.
Cost of twenty-stamp mill, freight, erection, &c.: The same ratio.
Minimum mining cost per ton of ore: One dollar and fifty cents per ton.
  Mine from which this is reported: Nisbet mine, Oregon City.
  Character of rock at that mine above: Open, reddish, decomposed quartz.
  Depth of mine: Two hundred feet.
Maximum mining cost per ton: Ten dollars per ton.
  Mine from which this is reported: Nisbet mine.
  Character of rock, &c., lower: Compact bluish quartz, with sulphurets.
Minimum reduction cost: One dollar and fifty cents per ton.

Name of mill, and number of stamps: Nisbet mill; eight stamps.

Character of process employed: Copper plates and an arrastra for blanket-washings.

Maximum milling cost per ton: Three dollars.

Average mining cost per ton: Five dollars.

Average milling cost per ton: Two dollars.

Average yield of ore: Twelve dollars per ton.

Remarks.—The surface rock is cheaply mined, and the gold saved by the simplest process, while lower down the hard blue wall-rock and compact quartz with sulphurets account for the high maximum rate.

Exhibit of producing mines in Oregon Gulch mining district, Butte County, California, on July 1, 1869, reported by John Nisbet.

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim, in feet.	Country rock.	Vein matter.	Average value.	Mills.
Nisbet Mine	Nisbet Company	Lode	North and south	45 to 60°	3,600	Schist	Quartz	$12 00	1
Sparks & Smith's Mine	Oroville Gold Mining Company	Lode	East and west	Vertical		Blue slate	Quartz		1
Spring Valley Mine	Spring Valley Company	Lode	North and south	45 to 60°	3,000	Schist	Quartz	12 00	
Cambria Mine	C. A. Halstead	Lode	North and south	45 to 60°		Schist	Quartz	10 00	1
Wm. Reese's Mine	Wm. Reese	Lode	North and south	45 to 60°		Schist	Quartz		1
Grummet & Co.'s Mine	Grummet & Co	Lode	North and south	45 to 60°		Schist	Quartz		1
Oregon City Mine	Oregon City Company	Lode	North and south	45 to 60°		Schist	Quartz		

List of mills in Oregon Gulch mining district, Butte County, California, on July 1, 1869, reported by John Nisbet.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Horse power of engine.	No. of stamps.	Weight of stamp.	No. of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	Cost of mill.	Crushing capacity per day.	Size of screen.	Height of screen above die.	Amount wood consumed per day.	Cost of treatment, per ton.
								In.	*In.*	*In.*				*In.*	*C'ds.*	
Nisbet Mill	Nisbet Mining Company	Oregon City	Steam	20	8	600	68	10	8	8	$12,000	12	42 by 16	5	1½	$2,00
Cambria Mill	C. A. Halsted	Oregon City	Steam	20	5	600	68	10	8	8	8,000	7½	48 by 16	5	2	2,50
Sparks & Smith Mill	Oroville Gold & Silver M'g Co.	Oregon Gulch	Steam	30	10	750	68	10	8	8	16,000	15	42 by 16	5	2½	2,50
Reese Mill	Wm. Reese	Oregon Gulch	Water	4												
Grummet Mill	A. Grummet & Co	Oregon Gulch	Water	4												

Remarks.—The Reese and Grummet Mills work arrastras alone, the rock being prepared for them by hand; no pans in use; only one arrastra to grind blanket washings. The cost of treatment is set down at $2,50, but it probably ranges from $2 to $4.

CHAPTER XIII.

PLUMAS COUNTY.

Both quartz and hydraulic mining has been carried on to quite an extent in the county, and some new discoveries are reported. Late in November good placer diggings were found on Wahponsee Creek, several of the claims paying as high as an ounce a day to the hand. The numerous tunnels near Sawpit have yielded rich dirt during most of the time in the summer.

Some of the quartz mines have given very satisfactory results, as will be seen from the following tables:

Estimate of costs of mining and reducing ores in Jamison district, Plumas County, California, reported by William P. Wilson, July 1, 1869.

Population of district: Two hundred.
Wages of first-class miners: Sixty dollars per month.
Wages of second-class miners: Fifty dollars per month.
Wages of surface laborers: Fifty dollars per month.
Cost of lumber: Thirty dollars per thousand feet.
Cost of mining timber: Five cents per linear foot.
Cost of freight from Marysville: Two dollars and twenty-five cents per hundred weight.
Cost of fuel: Two dollars and twenty-five cents per cord.
Minimum mining cost per ton of ore: Five dollars, including milling process.
Mine from which this is reported: Seventy-six, Mammoth and Eureka.
Character of rock at those mines: Quartz, containing sulphides ot iron, copper, zinc, and lead.
Depth of mine: Eureka, four hundred and fifty feet; Mammoth, four hundred and fifty feet; Crescent mine, two hundred and fifty feet.

Return of the production of gold and silver in the Jamison mining district, Plumas County, California, on July 1, 1869, reported by William R. Wilson.

Mill.	Owners.	Location.	Mine.	Number tons of ore.	Average yield.	Total product.	Time of running.	Average number of stamps running.	Whole number of stamps in mill.	Power.
Eureka	John Parrott & Co.	Jamison district	Quartz	6,300			April 1 to Nov. 30	28	28	*Water.
Seventy-six	Nave, Elwell & Co.	Jamison district	Quartz	250	$70 00	$17,500	April 1 to Nov. 30		2	†Water.
Mammoth	Conly & Luther	Jamison district	Quartz	Not as-	certained.				12	‡Water.

* Steam for two months in the year. † Two arrastras. ‡ Run very little the past year.

List of mining claims in Jamison mining district, Plumas County, California, on July 1, 1869, reported by William R. Wilson.

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Value per ton.
Eureka	John Parrott & Co.	Quartz vein	E. to W.	North	510 feet in length; average width, 20	Hornblende	Auriferous pyrites	$10 00
Seventy-six	Nave, Elwell & Co.	Quartz vein	N. to S.	East	1,000 feet in length by 4 feet	Syenite	Auriferous pyrites	30 00
Mammoth	Conly & Luther	Quartz vein	E. to W.	North	2,100 by 5 feet	Hornblendic	Auriferous pyrites	

List of mills in Jamison mining district, Plumas County, California, on July 1, 1869, reported by William R. Wilson.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Horse-power of engine.	Number of stamps.	Weight of stamp.	Number of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	Number and kind of pans.	Cost of mill.	Crushing capacity per day.	Size of screen.	Height of screen above die.	Cost of treatment per ton.
								In.	*In.*	*In.*			*Tons.*		*In.*	
Eureka	John Parrott & Co.	Jamison district	Water	40	28	750	65	9	8	9	7*	Built long since	45	4	3	$1 00
Seventy-six	Nave, Elwell & Co.	Jamison district	Water		2	1,800	15	90	10			[illegible]	[illegible]			[illegible]

Return of the production of gold and silver in the Cherokee mining district, Plumas County, California, for the year ending July 1, 1869, reported by M. B. Bransford, superintendent of the Crescent Mine.

Mill, Crescent; owner, M. Marcuse; location, Indian Valley; mine, Crescent; number of tons of ore, 15,000; average yield, ten; total product, 150,000; time of running, 280 days; average number of stamps running, 20; whole number of stamps in mill, 32; power, 120 horse-power engine.

Estimate of costs of mining and reducing ores in Cherokee district, Plumas County, California, reported by M. B. Bransford, July 1, 1869.

- Population of district: Five hundred.
- Wages of first-class miners: Three dollars and twenty-five cents per day.
- Wages of surface laborers: Three dollars per day.
- Cost of lumber: Twenty dollars per thousand.
- Cost of mining timber: Three cents per lineal foot.
- Cost of common powder: Three dollars per keg.
- Cost of quicksilver: Fifty cents per pound.
- Cost of freight from Oroville: One and a half cent per pound.
- Cost of fuel: Two dollars and fifty cents per cord.
- Minimum mining cost per ton of ore: Fifty cents per ton.
  - Mine from which this is reported: Crescent.
  - Character of rock at that mine: Gold quartz.
  - Depth of mine: Three hundred and forty feet.
- Maximum mining cost per ton: One dollar and fifty cents.
  - Mine from which this is reported: Crescent.
  - Character of rock, &c.: Quartz.
  - Name of mill, and number of stamps: Crescent mills; thirty-two stamps.
  - Character of process employed: Stamp and amalgamating plates.

Remarks.—The mine has been worked since 1862; it is in much better condition at present in relation to quantity and quality of rock, than ever before.

Estimate of costs of mining and reducing ores in Cherokee district, Plumas County, California, reported by John N. Blood, July 1, 1869.

- Population of district: Five hundred.
- Wages of first-class miners: Three dollars per day.
- Wages of second-class miners: Two dollars and seventy-five cents per day.
- Wages of surface laborers: Two dollars and seventy-five cents per day.
- Cost of lumber: Twenty-five dollars per thousand feet.
- Cost of mining timber: Four cents for round, and eight for square.
- Cost of common powder: Two dollars and fifty cents per keg.
- Cost of giant powder: One dollar and twenty-five cents per pound.
- Cost of quicksilver: Sixty-one cents per pound.
- Cost of twenty-stamp mill, freight, erection, &c.: Twenty thousand dollars.
- Minimum mining cost per ton of ore: Fifty cents.
  - Mine from which this is reported: Indian Valley Quartz Mills Company.
  - Character of rock at that mine: Quartz vein.
  - Depth of mine: Five hundred and ten feet.
- Maximum mining cost per ton: Three dollars.
  - Minimum reduction cost: One dollar and fifty cents per ton.
  - Name of mill, and number of stamps: Indian Valley Quartz Mills, twenty stamps.
  - Character of process employed: Wet crushing, amalgamating on copper plates.
- Average mining cost per ton: Two dollars and fifty cents.
- Average milling cost per ton: One dollar and fifty cents.
- Average yield of ore: Ten dollars and ninety-five cents per ton.

Remarks.—We have produced and worked 3,560 tons of rock for the last year, and I suppose we will keep on about the same for the remainder of the year.

List of producing mining claims in Cherokee mining district, Plumas County, California, on July 1, 1869, reported by M. B. Bransford.

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Value per ton.
Crescent	M. Marcuse	Gold quartz	E. and W	25° north	3,000 feet	Granite	Quartz	$10 00
Bon Accord	C. W. Cahalan	Gold quartz	SE. and NW	74° south	2,200 feet	Granite	Quartzose	10 00
Caledonia	Caledonia Quartz Mining Company	Gold quartz	SE. and NW	45° south		Conglomerate		
Comanche	Cunningham & Co	Gold quartz	SE. and NW	45° south	2,000 feet	Granite	Quartz	12 00

List of mills in Cherokee mining district, Plumas County, California, on July 1, 1869, reported by M. B. Bransford.

Name of mill.	Owners.	Location.	Kind of power.	Horse-power of engine.	Number of stamps.	Weight of stamp.	Number of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	Number and kind of pans.	Cost of mill.	Crushing capacity per day.	Size of screen.	Height of screen above die.	Amount wood consumed per day.	Cost of treatment, per ton.
						Lbs.		*In.*	*In.*	*In.*			*Tons.*		*In.*	*Cords.*	
Bull Frog	Bidwell & Co	Rush Creek	Steam	30	8	750	60	8	4	4		$8,000	16	1 by 4 ft.		2	$3 50
Crescent	M. Marcuse	Indian Valley	Steam	120	32	850	70	10	10	12	1 Wheeler	40,000	65	4 feet		8	3 00
Judkins & Kellogg	Judkins & Kellogg	Round Valley	Water	80	16	750	65	8	8	10	1 Wheeler	12,000	32	4 feet		8	2 00
Caledonia	Caledonia Company	Cherokee	Steam	40	12	750	65	8	8	10	1 Hopkins	12,000	24	4 feet		8	3 50
Dixie	Bidwell & Co	Dixie	Water	12	8	400	60	7	7	9		4,000	10	4 feet		8	2 00
Batchelder's	Batchelder	Dixie	Water	7	4	400	45	7	7	9		1,800	6	4 feet		8	2 00
Lone Star	M. S. Aschheim	Greenville	Water	12	10	600	50	7	7	9	1 Varney	8,000	15	4 feet		8	2 00
McClelland	Ogden & Co	Greenville	Water	6	5	400	35	7	7	9		4,000	6	4 feet		8	2 00
New York	L. G. Traugh	North Cañon	Water	20	12	600	60	9	7	9		8,000	24	4 feet		8	1 75
Pennsylvania	Treadwell & Co	Greenville	Steam	40	12	750	60	8	10	12		12,000	24	4 feet		8	3 00
Indian Valley	Treadwell & Co	Greenville	Steam	40	20	600	65	9	8	8		20,000	40	7 feet	9	2¼	3 25
Whitney	Whitney Company	Indian Valley	Steam	40	24	750	65	11	10	12		20,000	50	7 feet	9	2¼	3 50

Remarks.—The above comprises a list and capacity of all the mills in this district.

CHAPTER XIV.

ALPINE COUNTY.

The amount of mining done in this county during the year has been small; but many companies now seem to be on the eve of practical success. The topography of the county has led to the almost universal employment of adits for opening claims. This method of mining, though undoubtedly economical in the long run, demands more capital at the outset than is required for opening veins with inclines; since a tunnel (except in those lucky instances where it is at the same time a drift in the lode) must go through barren rock until the ore is reached, while the sinking of an incline permits the miner to gouge out by the way such bodies of paying rock as he may discover, and thus make the mine, in many cases pay for its own development. Consequently, the companies at work in Alpine County have suffered greatly for want of capital; and their operations have been frequently hindered or stopped for this cause. Refractory ores have also given them much trouble, and a good deal of time and expense have been wasted in experiments upon new patented processes.

The following partial returns will give some idea of the present state of affairs:

Exhibit of producing mines in Alpine mining district, Alpine County, California, July 1, 1869, *reported by John Weiss.*

Name.	Owners.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.
George Law	Judge Burbank	N. E., S. W.	East			Trap rock.
Good Hope	John Weiss & Co.	N. E., S. W.	East	2,250 feet	Porphyry	Trap rock.

Remarks.—The ore is of gold and silver quartz. The George Law has two tunnels, one 150 and the other 250 outcroppings, showing a good defined ledge. The Good Hope has a well defined ledge, tunnel of 225 feet in length tapping ledge at 150 feet in depth. Had several tons of rock worked at Pioneer mill. yielding from $11 to $13 per ton; have had assays as high as $200 per ton.

List of mills in Alpine mining district, Alpine County, California, on July 1, 1869, *reported by John Weiss.*

Name of mill, Pioneer; owners, San Francisco Company; location, Markleeville; kind of power, water; number of stamps, 10; weight of stamp, 400 pounds; number and kind of pans, 6; cost of mill, $25,000; crushing capacity per day, 20 tons; amount of wood consumed per day, 1 cord.

Remarks.—This mill has been idle for some time. Last spring several tons of Morning Star ore were tried by chlorination, (Küstel & Hoffman,) but meeting with no success, the process was abandoned. The wood consumed is for roasting purposes.

Estimate of costs of mining and reducing ores in Alpine district, Alpine County, California, reported by John Weiss, July 1, 1869.

Population of district: Five hundred.
Wages of first-class miners: Four dollars per day.
Wages of second-class miners: Three dollars and fifty cents per day.
Wages of surface laborers: Three dollars per day.
Cost of lumber: Fifteen dollars per thousand at mill, one to ten miles from mines.
Cost of common powder: Four dollars and fifty cents per keg.
Cost of quicksilver: Sixty cents per pound.
Cost of freight from Reno: One and a half cent per pound.
Cost of fuel: Four dollars per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: About fifteen thousand dollars.
Cost of twenty-stamp mill, freight, erection, &c.: Twenty thousand dollars.

Remarks.—Our mines have not been sufficiently developed and worked to enable me to give correct figures of the cost of working, &c., of our ores. Ores have been reduced from a number of our mines at a cost ranging from ten to fifty dollars per ton, according to their more or less rebellious nature; our free ores can be mined and reduced at the minimum cost of eight dollars per ton, owing to our abundance of water-power and fuel. Our ores will average, take the different mines together, fifty dollars per ton. We have four quartz mills in the county, doing custom work.

Return of the production of gold and silver in the Monitor mining district, Alpine County, California, for the year ending July 1, 1869, *reported by S. G. Lewis.*

Mill, Silver Creek; owner, D. Davidson; location, on Silver Creek; mine, Tarshish; number of tons of ore, *76; average yield, *$110; total product: *$8,360; time of running, off and on for two months; average number of stamps running, 8; whole number of stamps in mill, 8; power, 20 horse-power steam.

Remarks.—The run of two months was made early last year on Tarshish ore at a mill which it was not found profitable to work in, and as the company had no means to put up one and other trouble supervened, the mine has been idle since. The Tarshish company is reported as having succeeded in obtaining $75,000 working capital, and resumed operations.

Exhibit of producing mines in Monitor mining district, Alpine County, California, on July 1, 1869, *reported by S. G. Lewis.*

Name, Tarshish; owner, Schenectady Silver Mining Company; character, silver and gold; course, north and south; dip, east at angle of 32°; dimensions of claim, the company have ten parallel claims; only one deposit yet struck; country rock, decomposed diorite; vein matter, quartz slate; ore, antimonial sulphuret of silver, containing about 20 per cent. gold; average value, first class, $300; second class, $80; third class, $25, per ton; product for the year ending July 1, 1869, $8,360.

Remarks.—I call this a producing mine though not now being worked. It did produce early in the year and might now if worked; will start up soon again.

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* Estimated very near the mark.

List of mining claims in Monitor mining

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Ore.	Value per ton.
Monitor consolidated claims.	Monitor Consolidated Min'g Company.	Silver and gold.	N. and S.	E. and W.	25 parallel claims of 400 feet each.	Porphyry and diorite.	Quartz and quartz slate.	Sulphuret and antimonial sulphuret.	Not ascertained.
Imp'l Silver Quarries claims.	Imp'l Silver Quarries Company.	Silver and gold.	N. and S.	E. and W.	20 parallel claims of 1,000 ft. each.	Porphyry and diorite.	Quartz and quartz slate.	Sulphuret and antimonial sulphuret.	Not known.
Winchester claims	Winchester Min'g Company.	Silver and gold.	N. and S.	E. and W.	10 parallel claims of 1,000 ft. each.	Porphyry and diorite.	Quartz and quartz slate.	Sulphuret and antimonial sulphuret.	Not known.
Mountain claim	John P. Ray	Silver and gold.	N. and S.	W.	1,000 feet	Porphyry and diorite.	Quartz	Sulphuret and antimonial sulphuret.	$10 to $40.
Globe claim	Globe Gold and Silver Min'g Company.	Silver and gold.	N. and S.	E.	5,000 feet	Porphyry and diorite.	Quartz and quartz slate.	Sulphuret and antimonial sulphuret.	Not known.
Esmeralda and Alart claims, (Extension of Tarshish.)	I. G. & L. L. Lewis	Silver and gold.	N. and S.	E.	2,200 feet	Porphyry and diorite.	Quartz and quartz slate.	Sulphuret and antimonial sulphuret.	....
Tarshish claims	Schenectady Silver Mining Company.	Silver and gold.	N. and S.	E.	12,000 feet	Porphyry and diorite.	Quartz and quartz slate.	Sulphuret and antimonial sulphuret.	Say $75.
American claims	American Tunnel and Silver Mining Company.	Silver and copper.	N. and S.	E.	6,200 feet	Porphyry and diorite.	Quartz	Sulphuret and antimonial sulphuret.	....
Placerville claims	Placerville Gold and Silver Mining Company.	Silver and copper.	N. and S.	E.	4,000 feet	Porphyry and diorite.	Quartz	Sulphuret and antimonial sulphuret.	....

Remarks.—There are a thousand and one other claims in the district, but the above are the most prominent now. Except the Tarshish none of these claims are developed, but work is progressing on many of them, and with flattering prospects. The Morning Star, Monitor Consolidated, Imperial, Mount Bullion, Globe, and Michigan were working in December, 1869, with five men each, in tunnels, and expected to continue through the winter. Giant powder has been used successfully in the Imperial, Mount Bullion, Globe, and Monitor tunnels.—R. W. R.

List of mills in Monitor mining district, Alpine County, California, on July 1, 1869, repo by S. G. Lewis.

Name of mill, Monitor Consolidated; owners, Monitor Consolidated Mining C pany; location, on East Carson River, below the town of Monitor; kind of po water; number and kind of pans, not determined yet; cost of mill, not finished ; crushing capacity per day, will be 40 tons.

Remarks.—This mill is only partly finished; will crush with one of Whelple Stoner's crushers, and pulverize to fine dust with two of their pulverizers. We h already tried these machines and find them fully equal to the claims of the inven in everything.—S. G. L.

Estimate of cost of mining and reducing ores in Monitor district, Alpine County, Califo reported by S. G. Lewis, July 1, 1869.

Population of district: One hundred and fifty.
Wages of first-class miners: Four dollars per day.
Wages of surface laborers: Three dollars per day.
Cost of lumber: Twenty-six dollars per thousand, delivered.
Cost of mining timber: Twenty dollars per thousand.
Cost of common powder: Four dollars and fifty cents per keg.
Cost of giant powder: One dollar per pound.
Cost of quicksilver: Eighty cents per pound.
Cost of freight from San Francisco: Three cents per pound.
Cost of fuel, good pine wood: Three dollars per cord at mill.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: T thousand dollars, first-class.
Cost of twenty-stamp mill, freight, erection, &c.: Twenty thousand dollars, co plete and first-class.
Minimum mining cost per ton of ore of placing on dump: Two dollars per ton.
  Mine from which this is reported: Tarshish.
  Character of rock at that mine: Quartz slate.
  Depth of mine: From six-hundred-foot tunnel.
Minimum reduction cost in M. C. Mill to dust: Two dollars per ton.
Average mining cost per ton: Say three dollars.
Average milling cost per ton: As we shall have to roast our ores I cannot yet we think fifteen dollars will cover it.

Remarks.—I hope to be able next year to make more correct and full report, mill and mine will be turning out regularly soon.

CHAPTER XV.

SHASTA COUNTY.

Estimate of costs of mining and reducing ores in French Gulch district, Shasta County, fornia, (Highland mill,) reported by W. E. Hopping, July 1, 1869.

Population of district: Four hundred.
Wages of first-class miners: Seventy dollars per month and board.
Wages of second-class miners: Sixty dollars per month and board.
Wages of surface laborers: Fifty dollars per month and board.
Cost of lumber: Thirty dollars per thousand.
Cost of common powder: Five dollars per keg.
Cost of giant powder: One dollar and thirty-seven cents per pound.
Cost of quicksilver: Seventy cents per pound.
Cost of fuel: Two dollars and seventy-five cents per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Tw thousand dollars.
Minimum mining cost per ton of ore: About two dollars and fifty cents.
  Mine from which this is reported: Highland.
  Character of rock at that mine: Gold-bearing quartz.
  Depth of mine: Developed one hundred and fifty feet.
  Character of process employed: Amalgamating in battery and copper plates.
Average milling cost per ton: Two dollars and fifty cents.
Average yield of ore: Ten dollars per ton.

Estimate of costs of mining and reducing ores in French Gulch district, Shasta County, California, reported by Samuel Cooper, July 1, 1869.

Population of district: Four hundred.
Wages of first-class miners: One hundred dollars, including board, per month.
Wages of second-class miners: eighty-five dollars, including board, per month.
Wages of surface laborers: Seventy dollars, including board, per month.
Cost of lumber: Twenty-five to thirty dollars per thousand.
Cost of mining timber: Forty dollars per thousand.
Cost of common powder: Five dollars per keg of twenty-five pounds.
Cost of giant powder: One dollar and thirty-seven cents per pound.
Cost of quicksilver: Seventy-two cents per pound.
Cost of fuel: Two dollars and seventy-five cents to three dollars and fifty cents per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Twelve thousand dollars.
Minimum mining cost per ton of ore: About two dollars and fifty cents.
  Mine from which this is reported: Washington.
  Character of rock at that mine: White and blue quartz thickly sulphureted.
  Depth of mine: Developed four hundred feet from summit of hill.
  Name of mill and number of stamps: Washington; twenty-two stamps.
  Character of process employed: Common battery and copper-lined sluices.
Average milling cost per ton: Two dollars and fifty cents.
Average yield of ore: Fourteen dollars and fifty cents.

Return of the production of gold and silver in the ——— mining district, Shasta County, California, for the year ending July 1, 1869, reported by Samuel Cooper.

Mill.	Owners.	Location.	Mine.	Number of tons of ore.	Average yield.	Total product.	Time of running.	Average number of stamps running.	Whole number of stamps in mill.	Power.
Washington	Washington Company	French Gulch	Quartz	3,100	$14 75	$45,721 95*	180 days	8 to 10	22	Water.
Highland	W. E. Hopping	French Gulch,	Quartz	173	25 00	4,322 43†	40 days	5	10	Steam—20-horse.
Potosi	Morsehead & Co	Muletown	Quartz	100	50 00	1,947 64	30 days	4	4	Water.

* According to another report $53,811 42.
† According to another report $20,000, which probably includes other runs of the mill, aggregating 2,000 tons at $10.

Exhibit of producing mines in ——— mining district, Shasta County, California, on July 1, 1869, reported by Samuel Cooper.

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Ore.	Average value.	Mills.	Product for the year ending July 1, 1869.
Washington Mine	Washington Company	Lode	N.W. & S.E.	70° E.	3,150 feet—3 to 9 feet wide.	Slate and granite	Quartz	Gold	$14 50	1	{ $53,811 42 { 45,721 95
Highland Mine	W. E. Hopping	Lode	N.W. & S.E.	S. W.	3,000 feet—2½ feet wide	Slate and granite	Quartz	Gold	25 00	1	4,322 43
Potosi Mine	Morsehead & Co	Lode	N.W. & S.E.		1,500 ft.—18 to 20 in. wide.	Slate and granite	Quartz	Gold	50 00	1	1,947 64

Remarks.—The Potosi has not been worked since May 1; others doing well. Washington mine has been worked since its discovery, in 1852. Highland since '861.

Name.	Owners.	Character.	Course.	Dimensions of claim.	Country rock.	Vein matter.	Ore.	Value per ton.
Washington	Washington Company	Lode	N.W. & S. E.	3,000 feet	Slate and granite	Quartz	Gold	$14 50
Highland	W. E. Hopping	Lode	N.W. & S. E.	3,000 feet	Slate and granite	Quartz	Gold	25 00
Potosi	Morsehead & Co	Lode	N.W. & S. E.	1,500 feet	Slate and granite	Quartz	Gold	50 00
Honeycomb	M. Shea & Co	Lode	N.W. & S. E.	1,500 feet	Slate and granite	Quartz	Gold	10 00

Remarks.—There are no placer claims, or none that can be properly denominated "live" claims, or of any extent; and no hill claims deserving of notice. Of the quartz claims enumerated above only the two first are working, though the others have ledges of no mean pretensions, but no capital to develop them.

List of mills in ——— mining district, Shasta County, on July 1, 1869, reported by Samuel Cooper.

Name of mill.	Owners.	Location.	Kind of power, water or steam.	Horse-power of engine.	No. of stamps.	Weight of stamps.	Number of drops per minute.	Height of drop.	Diameter of die.	Diameter of shoe.	Number and kind of pans.	Cost of mill.	Crushing capacity per day.	Height above die.	Amount of wood consumed per day.	Cost of treatment.
								In.	*In.*	*In.*			*Tons.*	*In.*	*Cords.*	*Per ton.*
Washington Mill	Washington Company	French Gulch	Water		22	600	60	6	8	8	None	$12,000	22			$4
Highland Mill	W. E. Hopping	French Gulch	Steam	20	10	500	60	6	8	8	None	9,000	10	15	3	Not known.
Honeycomb Mill	M. Shea & Co	French Gulch	Water		8	600	60	6	8	8	None	4,000	8			Not running.
Potosi Mill	Morsehead & Co	Muletown	Water		4	600	60	6	8	8	Arrastra	5,000	4			Not running.
Mammoth Mill	E. Lewin & Co	Quartz Hill	Steam	36	8	600	60	6	8	8	2 wheelers	24,000	8			Not running.
Jollie Mill	Jollie & Dosh	Muletown	Water		4	300	60	6	8	8		1,500	3			Not running.
Peck's Mill	Willard & Conger	Chicago	Water		4	500	60	6	8	8	2 wheelers	6,000	4			Not running.
George's Mill	W. H. George	Lower Springs	Steam			Litt	le dev	il c	rus	her	1 wheeler	1,250	2			Not running.

Remarks.—The Washington and Highland are the only mills that are running; some of the others have not been at work for two or three years, and have no permanent ledges. The two first-mentioned are in flourishing condition.

CHAPTER XVI.

DEL NORTE COUNTY.

Under this head I insert part of an interesting account of the gold coast of California and Oregon, by Mr. Solomon Johnson, published in the Overland Monthly for June, 1869:

> That the beach sands of the upper coast counties of California and the lower coast counties of Oregon are auriferous is well known. The sands contain gold and platinum in minute scales or particles, and a large percentage of magnetic iron or iron sand, commonly called black sand, which is mixed or blended with the common beach sand, the bulk of which is composed of quartz-crystal and gray blende. These sands carry sufficient gold to make mining for it remunerative in localities that occur along the coast for a distance of three or four hundred miles. Gold mining at certain points has been carried on to a considerable extent for the last seventeen years. Beach mining, as it is called, differs widely from placer mining or any other kind of gold mining. The mode generally adopted by the miners is to avail themselves of the aid of natural laws governing the winds, tides, and surf, which act as a great natural separator, separating the lighter and useless from the heavier and precious particles. The force of the wind drives heavy swells upon the beach at high tide, and with them a body of sand more or less in quantity, according to the height of the winds and tide, and upon the receding or ebb of the tide the surf lashes the beach and carries back with the undertow the lighter portions of the sands, leaving a portion of the iron sands, gold, and platinum, whose specific gravity causes them to be precipitated to the bottom and thus left behind. At low water the miners go down upon the beach and scrape up the iron sand, (which is generally left by the tide in thin layers,) and pack it back out of the reach of the surf, when it is washed, separating the gold from the matrix iron sand. The usual mode of washing is with a small stream of water in a sluice, terminating on an apron or tom, with turned-up sides and ends, the bottom perforated with small holes, under which is a wooden box set slightly sloping, the bottom of which is covered with amalgamated sheet copper. The sands containing the small particles of gold are washed upon the apron, and passing through the small holes, strike vertically upon the copper below, the gold adhering to the copper, while the sands pass off through an opening in the lower end of the box. This primitive contrivance (although stationary) is called a "machine." Such a mode of working is necessarily imperfect, as all the gold that does not instantly adhere to the copper is washed off and lost. Miners are aware that rusty or coated gold has no affinity for quicksilver, and therefore will not adhere to amalgamated copper. Again, the great specific gravity of the iron sand renders it much more difficult to separate than light earth, as in placer mining.
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> Within the last three years a new and heretofore unknown field or source of mining has been discovered, *i. e.*, old deposits of iron sand containing gold. These deposits lie back of the present beach and above high-water mark, and consist of extensive layers of iron sand, from a few inches to three and four feet in thickness. Thus far but three of these ancient deposits have been discovered: one at Crescent City, in Del Norte County, one at Randolph, in Curry County, Oregon, and one, recently, in Klamath County, five miles below Trinidad. At Randolph the stratum of iron sand lies two hundred and fifty feet above the surface of the ocean level and three miles back from the present beach. Above this stratum of iron sand are sixty feet of common beach sand, and on top of it a forest of immense cedar trees.
>
> As before stated, the existence of auriferous sands upon the coast is generally known, but the existence of beach sands at a high elevation above the present ocean level is not generally known; in fact, it is a sealed book to most Californians, and even to many people living upon it. My attention was first attracted to it by seeing layers of beach sand and gravel on the top of the bluff at Trinidad, in Klamath County, and upon inquiry and investigation I found that the beach sand extended back from the coast for fifteen or twenty miles, and in some places at an elevation of twelve hundred feet.
>
> At Trinidad and elsewhere along the coast there are cone-shaped conglomerate rocks, whose heads are raised up out of the ocean. These rocks are made up of beach sand, pebbles, shells, &c., and must have been formed above the water-line; at the same time, the bluffs above the ocean level (where exposed, and where ravines are cut through the upper strata of beach sands and gravel) reveal primitive rock. At Gold Bluffs below the mouth of the Klamath River, the "bluffs" attain a perpendicular altitude of four hundred feet, and are composed of layers of beach sand, gravel, and washed boulders cemented together, underneath which are the trunks of immense redwood trees, lying horizontally, and stumps of trees standing in place below the present ocean level. The position of these trees and the conglomerate rocks, and the great depth and high altitude of the deposit of sand lying in regular strata, with the same gradual formation as with the present ocean beach, will disprove the theory of this extensive tract of country being caused by any sudden upheaval, and show, on the contrary, that what

anges have taken place have been gradual, extending through a great period of There must have been a gradual depression, and afterward a gradual elevation, sequently a partial depression again, or else the ocean has not always remained esent level. The same phenomena exist in New Zealand and in Australia, where e peculiar auriferous sands, lying in regular strata far above the ocean level, are h the same as here. There the miners drift in on the face of the bluffs, following y" strata, which they call "terrace mining," and beach mining is carried on in e way as here. Here, as in New Zealand and Australia, the auriferous sands far out in the ocean. Opposite Crescent City, ten miles out to sea, gold was y sinking a lead, with tallow on the lower end—fine particles of gold adhering allow. The beach sands as far down as San Francisco contain gold, but in such uantities that it will not pay for working. The same may be said of the beach s far up as Puget Sound; the "paying" belt being within the boundaries above d.

the coast on this sand belt, in the counties of Humboldt, Klamath, and Del he finest forests of redwood, fir, spruce, and Oregon pine cover this immense m the beach back to the foot-hills. In Oregon, the redwood gives place to the except a thin layer of vegetable mold, there seems to be no soil. The roots of es and shrubs spread out upon the top of the ground, and seem to take their ment from the atmosphere, which is always kept moist by the dense fogs that perpetually hang over the coast. This seeming sterility of the common beach more apparent than real, as the sands contain a multitude of minute sea-shells, re almost wholly composed of carbonate and phosphate of lime, the strongest t of fertilizers, and account for the great fertility of clean beach sand. Between trees, which stand very thick, is an undergrowth of brush and vines, so thick an cannot travel through it without cutting a trail. Ferns grow from ten to feet high; salmonberries, huckleberries, strawberries, and many other kinds of it, grow in great profusion and excellence. Except a few trails leading to im- points, this sand country north of Humboldt Bay is a *terra incognita*, and will y remain so until the country is opened with railroads. The coast is dan- o commerce.

e discovery of most of the gold-fields has been the result of accident, so also existence of gold in the beach sands, which was unexpectedly found by Mr. du Bertram, in 1850. With a party of prospecting miners, he was toilsomely ing down the coast in quest of provisions. They were obliged to follow the t being impossible to strike through the country, on account of the impenetra- le or underbrush. In passing along the beach at the upper Gold Bluffs in Kla- unty, they were surprised to see the sands presenting the appearance of one et of gold. So clean had the great natural separator, surf and tide, done its at the surface of the beach was nearly covered with gold, and it was some fore the astonished party could realize the fact that what to them glittered eality gold, and not an optical illusion. As they became satisfied that it was on, their natural cupidity began to show itself; here to them was untold wealth, to profit by the discovery and keep others from coming in and reaping the they considered theirs by right of discovery, was to them the all-important . They had no time to waste in idle speculations, as the demands of hunger ed them to pursue their journey to Trinidad, thirty miles distant, without de- re there was a small settlement and a rancheria, and where they could replen- empty larder. Scraping up a few handfuls of the golden sands, with light hearts ty stomachs they tramped on, keeping to themselves the secret of their dis- At San Francisco they exhibited their sands (which proved nearly one-half a few influential and favored parties, who speedily formed a company and d on a revenue cutter to take formal possession of the fabled Ophir. In order the secret from the people of Trinidad, (the nearest landing-place,) they lay off l Bluffs, where an attempt was made to land through the surf in a small boat. sequence was that the boat capsized and out of the six men who embarked five owned, and the sixth, which proved to be Mr. Bertram, was hauled out of the n exhausted condition by an Indian who happened to be watching the move- The remainder of the party, deeming it unwise to make any further attempt to sail for Trinidad and from thence proceeded on foot up the coast to the bluffs. for human hopes and expectations! Where they expected to find the beach with gold, no gold was to be seen. They had made no calculation and had no of the many changes that had taken place at each successive tide since the covery. Disappointed, heart-sick, tired, and foot-sore, they retraced their teps to Trinidad, and there embarked for San Francisco, leaving behind the g castles that their feverish imaginations had built high up in those faithless Mr. Bertram and one or two others were still sanguine that what they had n a propitious tide would reveal again. The result has been that the beach worked, when the surf and tides were favorable, with not fabulous, but mod- fits to the favored owners from that to the present time, and bids fair to last g time in the future. Thus began and ended the Gold Bluffs bubble.

SECTION II.—NEVADA.

CHAPTER XVII.

THE COMSTOCK LODE.

ter, prepared with the assistance of Mr. C. A. Luckhardt, and y on his notes and observations, is a continuation of the given in my report for 1868, which is thus brought down to ınd in some cases to a later date. For facility of description, divide the 19,000 feet of explored ground on the Comstock arts, viz:

ırthern portion, extending from the Utah to the Chollar , a distance of 12,170 linear feet.

iddle portion, extending from the Chollar to the Imperial tance of 1,794 linear feet; and

uthern portion, extending from the Imperial North to the nan, a distance of 4,775 linear feet.

further locations, both north of the Utah and south of the which I will afterwards refer.

n portion of the vein.—My last report showed the existence inctly separate ore bodies, on all of which work has been p to date, while neither of them has as yet been exhausted of

ncing on the north, I described the first body, very irregular 140 to 150 feet in depth, and about 250 feet in length, lying n the Sierra Nevada Company's ground. During the latter he year ending July 1, 1869, it has been very vigorously the Sierra Nevada Company, yielding them ore, carrying ree gold, of the net mill value of five to ten dollars per ton. nstances, such as the erection of a mill at the mine, the t through tunnels, &c., permitted the extraction of this low s, leaving the company a small profit per ton. There are ds of tons of ore, varying from three to ten dollars per ton, his body. The company have explored the ground partially red feet below this ore body, but finding the vein barren of cided to dispense with further explorations in depth for the

of the above we have 1,600 to 1,700 feet of ground which een productive. We then come upon the second ore body, om the North Ophir for over six hundred feet horizontally the California ground. This body extended for 650 to 700 ly below the surface, and yielded in former times immense rich ores. It is practically exhausted, excepting some low or the profitable treatment of which even the present reduced ing are still too high. Its great width in many places caused of pillars of fair ores at the time it was worked; and these been attacked by individual contractors within the past year. s have often been successful where it was impossible for the companies themselves to extract the ores with profit. Want of capita or of confidence has prevented the work of exploration from being carrie on as vigorously as might have been expected by many, in order t develop this ground below the depth of 650 or 700 feet. The main wor of this character thus far has been the sinking of the new Ophir sha for 700 feet depth, which brings them 280 feet below the point whe ore body No. 2 pinched out. At that depth nothing was found bu barren porphyries filling the vein, and it seems doubtful whether an ore will be met with at this depth, so far north from where the last ore body terminated. A single drift from east to west, in a piece of ground over two thousand feet in length along the vein from north to south, does not, however, furnish enough facts to permit a positive opinion as to the possible worth of the vein at this particular point. The ground south of this ore body for over 1,300 feet, including south portion of the California Company, Central No. 2, Kinney, White & Murphy, Sides, Best & Belcher, has been lying idle for years. It was explored to various depths, from 100 to 500 feet below the surface, but never with any system; and nothing can be said as to its value. It is very probable that much ore exists here, but it has yet to be laid open to view. The Central No. 2, Kinney, White, Murphy and Sides, comprising 860 feet, have been consolidated, and a shaft, now 300 feet deep, is being sunk with the object of thoroughly investigating this ground for ore. It is my impression that they will meet with success in depth, as they will most probably discover the continuous outcrop (blind here for 1,800 or 1,900 feet) of the Comstock vein. This outcrop has been ore-bearing wherever struck all along the line of the vein for over 13,000 feet in length, and if discovered here should insure the newly-formed company an indefinite period of lucrative mining.

3. The third ore body, commencing at the Gould & Curry Company's ground, extended south for 2,330 feet horizontally, and its terminus was discovered 1,089 feet below the outcroppings. There were many smaller outlying bodies of ore running generally parallel with it, and it split in several places, causing very extensive ore chambers at the points of reunion. It was this body and its smaller companions which gave the Gould & Curry, Savage, and Hale & Norcross their unequaled fame. It alone has yielded, as nearly as I can ascertain, over $12,500,000 worth of bullion. It has been exhausted of its ores, with the exception of about eleven thousand tons in sight in the Savage and five thousand tons in the Hale & Norcross, and its limit in depth has been demonstrated. It is very natural that such a colossal mass of ore, worked so rapidly as has been the case here in Washoe, as much as 650 tons of ore being extracted daily for a considerable period, should not be entirely exhausted in two years. Places which, in the hurry of operations, were overlooked are now being overhauled. Old abandoned works are repaired and continue to yield a limited amount of fair ore daily. For example, one parallel branch of this body was first discovered three hundred feet below the surface in the Savage Company's ground. It descended for two hundred feet, was there dislocated sixty feet from west to east, and, this dislocation being misinterpreted, was abandoned over a year ago as having closed out against the east clay wall. Since that time it has been found again, and worked for over one hundred feet vertically, varying from three to thirty-five feet in width of first-class ore, ($85 to $120 assay per ton,) and from thirty-five to one hundred and forty feet in length horizontally. It alone has produced for the Savage mine three dividends, amounting to $208,000 net profit. This body was called the Potosi Chimney. At present it is again exhausted, having run out in depth into a

et wide quartzose seam, full of clay and clayey matter, dipping lat to the east and south. It is still under further exploration, is doubtful if it will again widen out into a body of ore. Its east- undary (clay) has been broken through, showing the east country eyond, a circumstance unfavorable to a continuation of ore.

re is no doubt that similar conditions are likely to occur again ground surrounding this large third ore body; and it is with the of finding yet other parallel ore seams, though not with the ex- ion of as good quality or large quantity as the Potosi Chimney that work is at present carried on in all of the three above-named , in what they term their old works, from the surface to a depth of ndred feet.

hin the three mines (a space of say 2,400 feet, horizontally) through this large third ore body swept, explorations have been carried on the year for three hundred feet in depth. Cross-sections and udinal drifts have been run, amounting to an aggregate of five nd linear feet; the limits of this third ore body in depth, both and south, have been determined. These explorations have also ed an entirely new body of ore in the 1037-foot level of the Hale cross mine. It was first met with in sinking a small winze below 0-foot level and then found ninety-three feet west of the Hale & ss shaft, in their 1037-foot level, where it showed again the dip nd the sinking of its upper edge to the south, which are phenom- aracteristic of all the ore bodies in the North Comstock. It has een laid bare for 260 feet in length, showing from six to twenty-one dth of pay ore. Its ores are somewhat different from the ores of per bodies. They contain more galena, and iron and copper s, and traces of zincblende. In a word, they are "baser," and, in uence, not as docile in wet amalgamation. This body promises to ewhat extensive. The ores may be called thirty-dollar mill ores, in places they have milled $60 to $65 per ton. They are not rly distributed through the thirty-seven to forty feet quartz-width ch they occur. Large pockets of quartz, worth only $3 to $10 per ll frequently change places with rich ore: for twenty feet in length dy will give sixty-dollar mill ore, and again for fifteen feet or so fteen-dollar mill ore.

as already yielded largely in ore in the Hale & Norcross lowest where it has been extracted for twenty-eight to thirty-five feet in by over one hundred and twenty-five feet in length, and has appearance of continuation in depth. Moreover, it lies, where l upon, over one hundred and twenty feet to the east from the all, and has, therefore, should it even stand vertically, one hundred irty-five feet to pinch out in before it will meet the west wall. ale & Norcross is now deepening the main shaft, which will cut e body seventy-two feet below the present lowest level, (1037-foot.) Savage shaft has attained a vertical depth of 958 feet, and l at this depth a quartz body twenty-one feet wide, which carries -simile of the ore of the Hale & Norcross body, but only in small s and pockets. It is probable that these twenty-one feet of are the northern portion of that Norcross ore body. There are reasons to believe this, but it is not absolutely certain, as three d feet horizontally and eighty feet vertically, of unexplored ground etween the two explored points. Should this prove to be the case, ht expect this newly discovered body to be of large dimensions; uld, in fact, know it to be already 473 feet in length, but how much of that length would be pay ore it is impossible to say. The ores of this body lie very irregularly, in bunches and pockets, as I have remarked.

By these developments, and others to be hereinafter described, in the middle and southern portion of the Comstock, we are strengthened in the opinion that as long as the west wall stands regular and undisturbed, whatever be the case with the eastern boundary of the vein, so long we may expect the occurrence of new quartz bodies in depth. The ores, however, become poorer, more refractory to the simple "Washoe" method of extraction, and more irregularly deposited through the accompanying gangue than they were in the superficial bodies.

4. Going further south from the Hale & Norcross and entering the Chollar Potosi mine, we have the fourth ore body, which has been worked, August, 1869, to the depth of five hundred feet below the outcrop for a distance of nearly one thousand feet, horizontally. The widest portion exposed last year was 123 feet; ore has been extracted in places, since then, for nearly two hundred feet in width. Very extensive explorations have been carried on in depth through the Chollar Potosi shaft within the last year. The ground has been prospected to a depth of 1,220 feet below the surface, but the vein was found to be filled with porphyries, showing only very narrow quartz seams sparingly distributed and carrying merely traces of ore. Meeting in depth neither ore nor even promising indications, the company devoted attention to the upper old mine, which has been overhauled and re-explored from the surface to a depth of over five hundred feet, with great success. Ground which was looked upon as exhausted has yielded largely in ores; and in the extreme western portion of the vein, near the surface, where no ore was ever suspected to exist, very fair mill-rock has been found in abundance. For a space of over three hundred feet (measuring from east to west across the vein) on the surface, ore has been extracted in large quantities; and from appearances the company has yet six or eight months' supply of ore, worth, probably, $16 to $22, (mill value,) in sight, representing about fifty thousand tons, which will pay a profit at the present mill rates. There is, aside from this estimate, a vast amount of ore of lower grade in the mine, which will prove valuable at some future day when milling rates will be still further reduced.

From the above description it will be seen, that in the last year, especially in the latter portion of it, the leading mines situated on the North Comstock have had to attack their old works for ores, which had become valuable from local circumstances. The workings in depth have proven so far only a drain on the treasuries of the different companies; what new developments have been made, are but a small compensation for their incurred cost. It is true, more prospecting work might have been carried on, in the space of nearly 12,500 feet, than has actually been accomplished; but even this latter would possibly not have been undertaken had not the old ore bodies held out so well. Prospects north are certainly not very flattering at present, though there are 1,500 feet in one place, and 5,300 feet in another, (along the course of the vein,) not explored in depth, viz: between Gould & Curry and Ophir, and between Ophir and the Utah Company's ground.

II. *Middle portion of the vein.*—Under this name I designate the ground from the Chollar Potosi South, to the Imperial North, 1,794 linear feet, occupied by the Bullion, Exchequer, Alpha, Treglone and Imperial North.

As I stated in last report, this ground contained the commencement of two extensive bodies of ore, especially the western one. This included

tcroppings, which have, with the exception of some low-grade ore,
xhausted in this portion of the vein. Small pillars left in early
gs, and old stopes, packed with the "deads" of former days, con-
o produce limited quantities of ore, principally in the Alpha and
ial. Two hundred tons of ten-dollar to fourteen-dollar mill-ore
ver the daily yield from the entire 1,794 feet of vein length.
the past year, explorations have been carried on in the Bullion,
, and Imperial, and 260 feet of further depth have been pros-
. The Bullion has obtained a depth of 1,400 feet; the Imperial,
eet; Alpha, 1,000 feet. The result has been, that the vein is found
from 93 to 130 feet in width, and to show more porphyry inter-
with the vein matter, which is highly impregnated with iron pyrites.
has been found in the Bullion as wide as 43 feet, but carrying
aces of ore through the mass; the Imperial shows from 15 to 30
quartzose matter, likewise bearing ore in traces only. The Alpha,
lowest level, exposes the vein 96 feet wide, filled principally with
porphyry which divides the quartz, leaving seven feet close to
st wall, and three to four feet near the western wall. Both these
show ore, but of no considerable value, consisting principally of
rets of lead and zinc, carrying silver in traces. In the Alpha,
en feet of quartz underlying the east clay, when first discovered,
reat hopes for a bright future; small boulders of good ore were
imbedded in the porphyry immediately underlying this quartz;
exploring the ground upwards, some three or four feet of fair ore
ncountered. It was, however, soon worked out, having yielded
o hundred tons of forty-dollar mill ore. Explorations are still
on in all these three mines, with the hope of meeting with an
ly in the quartz mass, now developed at the lowest depth attained.
efforts will probably be successful; but the vast amount of iron
gives ground to fear that the ore will prove, when found, to be
ry refractory nature.

South portion of the vein.—Including the ore which existed in
ide or middle portion of the Comstock, I mentioned last year the
ce of seven distinctly visible bodies or zones of ore in the Com-
taking the ground from the Bullion to the South Overman.

he first, which extended from the Alpha to the Crownpoint, and
had been worked for over 2,300 feet in length, with some inter-
barren ground, is not yet fully exhausted. The Yellow Jacket
ucing from 60 to 70 tons daily from it, of the average mill value
. Belcher, Overman, and Kentuck have also to extract ore from
but it is impossible to say how much may be expected from their
s.

he second, which commenced south of Exchequer, extended for
t southward, and terminated in the Imperial South, may be con-
as exhausted. Some little ore may yet remain; but it is doubt-
ts extraction would leave a profit to either of the companies.

he ore, which was left at the date of my last report in the ore
ommencing in the Imperial South, and extending into the north-
rtion of the Yellow Jacket, (where it had been worked to a depth
feet below the surface,) has been exhausted.

he fourth body, the horizontal length of which was nearly 1,200
mmencing in the Yellow Jacket mine and extending partly into
lcher ground, although "worked out," as was supposed last year,
ven considerable ore since from smaller parallel bodies, pillars,
ound at former times insufficiently explored, in the extreme
a portion of the vein. In the Kentuck Mine it reached its maxi-

mum width, and continues there to yield daily from 50 to 75 tons of twenty-eight-dollar to thirty-dollar mill ore. The Belcher Company has done little work in its old workings, through which this body went, but has lately reopened the ground, and will produce from it, I think, several thousand tons of ore. None of these four bodies extended more than 500 feet below the outcroppings, except in the Imperial mine, the body designated as No. 2. Search has been made to find their continuation in depth, but without satisfactory results.

5. In the Segregated Belcher and Overman occurred a body very irregularly deposited, which has yielded largely in ores. It has been explored for 1,200 feet in length, and over 450 feet below the surface; its best ores are exhausted, but the work of extracting low-grade ore continues, and at times a nest of rich ore is met with, but of no great dimensions. It will probably give yet 4,000 tons of low-grade ore.

6. At the Yellow Jacket, Kentuck, and Crownpoint mines, ore body No. 4 had its terminus about 500 feet below the surface. Explorations last year proved a dislocation of the entire vein matter from west to east, for about 400 feet horizontally. An ore body was discovered 462 feet east from where ore body No. 4 closed out, in the 500-foot level of the Crownpoint mine. It dipped east, sank northward, was found to course through Crownpoint North, Kentuck, and into Yellow Jacket, where its northern terminus has been demonstrated, 197 feet north from the Yellow Jacket south line in the 900-foot level, giving for this body a horizontal length of 491 feet, or, diagonally, a length of 630 feet. It varied in width from 8 to 39 feet, and has been nearly or quite exhausted in Crownpoint. Kentuck extracted ore from it for nine months, and has, according to last estimate, between 11,000 and 12,000 tons of thirty-dollar mill ore yet standing between the 700-foot and 900-foot levels. The Yellow Jacket has extracted the greater portion of the ores of this body, but has yet about 5,000 tons of twenty-seven-dollar mill ore standing above the 900-foot level. As work progressed on this fine ore body, it was found that it will not pay to extract its ores below the 900-foot level in Kentuck, while the 900-foot level of the Yellow Jacket showed the ore of excellent quality, and there is no doubt but it will extend into the Yellow Jacket 1,000-foot level, when opened.

A great deal of good ore from this body has been lost; and it is very doubtful if the above estimate of 12,000 tons of twenty-seven-dollar mill ore (standing in Kentuck) will hold good, from the fact that the disastrous fire which began April 7, 1869, in the Yellow Jacket, Kentuck, and Crownpoint, caused the caving of much of the partially worked ground between the 600-foot and 900-foot levels. The slopes which took fire have been burning ever since, and are on fire in places yet; and it is only with the greatest circumspection and care that work can be carried on in the neighborhood of the burning or charring mass of timbers, so as to get at the ore, and at the same time to cool the ground gradually without giving air to the carefully inclosed, smoldering, chaotic labyrinth of ore, caved ground, charring timbers, ashes, and dust. The suspension of artificial ventilation, leaving the workmen to labor in an atmosphere pregnant with carbonic oxide, &c., and innumerable other naturally-occurring obstacles, have caused all work for the past four months to progress very slowly, and made it very expensive. Moreover, the ores could not be assorted, and in consequence of these evils, the mines, which would have given a revenue, ran in debt.

Crownpoint was the first, and in fact the only mine on the southern portion of the Comstock, which carried on explorations in depth. The

900-foot level shows the above-described ore body to have passed away from this mine into Kentuck; but a quartz seam, varying from four to nine feet in width, has been followed and prospected on this level for several hundred feet, showing, however, only traces of ore. Explorations have been carried 200 feet deeper within the last year, and levels have been opened at 1,000 and 1,100 feet; but cross-sections through the vein show a quartzose mass with only traces of ore. Sulphurets of iron are found thickly disseminated in the porphyries which lie in close contact with the quartz. This can scarcely be regarded as a good sign for finding tractable ore in quantity. In the Yellow Jacket mine, from where ore body No. 3 closed out, south to where ore body No. 4 commenced, (a horizontal distance of over 780 feet,) there had been but little exploration carried on, although the ground was favorable for the existence of ore. The 730-foot level was opened northward, and disclosed a narrow quartz seam with some ore. The 810-foot level was opened and demonstrated eleven feet width of ore, which has been followed for 280 feet, showing from three to eighteen feet width of thirty-five-dollar mill ore. The 900-foot level was then opened, which showed the newly found ore body of the 810-foot level to be from fourteen to eighteen feet wide, carrying extremely rich seams and bunches of ore. It has been followed for sixty feet, thus far, north and south, and gives forty dollars mill ore. This body does not stand in communication with any ore body heretofore discovered; it has every appearance of being of very large dimensions, and has improved very materially in depth in the last 100 feet explored, so that Yellow Jacket has to all appearances a bright future.

Like the ore found in Alpha 1,000-foot level, and Hale & Norcross 1,037-foot level, this body has also a considerable intermixture of baser metals, which was not the case in the upper ore bodies. Its ores are often in nests, very rich, and alternate abruptly with barren quartz or even porphyry. The same phenomenon was also visible, but not to so great an extent, in ore body No. 6.

From the above description it will be seen that there is a probable reoccurrence of new ore bodies in the Comstock, in depth, so long as the west wall remains firm. Within the last year work has been continued on the formerly discovered eleven bodies of ore, some of which are enirely, and others not quite, exhausted; and two new bodies only have been met with. It is true that explorations, vertical and horizontal, would have been pushed to twice or thrice their actual extent; and had his been done, it is very probable that there would be more ore in sight. Yet, it is certain that the actual value of the Comstock has diminished materially within the past year. The bullion product has been, under he circumstances, large; but it has mainly come from ground on the vein which was known to be valuable *before* the year commenced, rather than from newly developed ground in depth.

It is very probable that the coming year will give us an equal yield if not a larger one than the foregoing, as railroads, &c., now facilitate all mining and milling operations enormously, and the vast amount of low-grade ore (estimated, as closely as possible, to amount to 3,500,000 tons of ten-dollar to fourteen-dollar mill ore standing in the eleven old ore bodies, not including new developments made) which yet exists along the vein may be beneficiated hereafter, while hitherto only fifteen-dollar to sixteen-dollar mill ore has been thought worthy of attention.

The two newly discovered ore bodies give every promise of large dimensions and of a quality insuring a handsome revenue to the respective mines in which they are situated. They are not explored sufficiently to enable me to speak with certainty as to their value, but allowing them their highest probable extent and richness, the fact remains that out of 19,000 feet of length of ground along the course of the vein there were, to an average depth of say 600 feet, about 6,000 feet length of productive ore ground; while between that depth and 1,000 feet, we have at present, though, it is true, explorations have been but partial, only 730 feet length of productive ore ground actually developed.

It has been the experience, thus far, that on this vein the deeper ore bodies are smaller than those near the surface. Their ores occur less uniformly distributed through the gangue, and are more refractory, an evil which unfortunately threatens to increase as greater depths are attained. It is true that nests and small deposits of extreme richness occur at intervals, but not in sufficient quantity to compensate for the increase of cost for their extraction, to say nothing of the inevitable expense of prospective and accessory work which all falls to the cost of mining. On the other hand, the cost of extraction and beneficiation of the ores will hereafter be decreased. The Virginia and Truckee railroad from Virginia to Carson, along the Carson River, began running in November, and milling facilities by water-power will be furnished along the river, reducing the price of reduction probably fifty per cent. below former rates. Many of the shafts, belonging to the leading mines, have attained sufficient depth to be close to the west wall of the vein, or at least not very far from it. Three of them, Gould & Curry, Chollar, and Crownpoint, have already pierced it, and will doubtless be changed to inclines, as the Chollar and Bullion shafts have been. In working through inclines, one-third or one-fourth of the shaft-area (according to the size) becomes useless, which augments the cost of hoisting by one-third or one-fourth of what it is when the main exit of the mine is vertical. This fact will compel, in course of time, the consolidations of several adjoining companies to work through one shaft, a measure which ought to have been adopted long ago.

As above remarked, two new ore bodies have been discovered within the last year by explorations in depth; one in the northern and one in the southern portion of the vein. The latter promises to be the more valuable. Other and fruitless prospecting work has not inspired much hope of soon discovering fresh ore. On the contrary, we find north of the lately-discovered ore the vein filled principally with feldspathic porphyry in various stages of decomposition up to plastic clay; small, irregularly deposited barren quartz-seams have now and then been encountered; the porphyry is impregnated with iron pyrites; and lime, as both carbonate and sulphate, has been found to increase gradually, and replace the quartz more and more as depth on the vein has been attained. As far as our experience of this vein has gone, the analogy of these phenomena is anything but encouraging in leading us to believe in a speedy recurrence of ore. In the southern portion of the Comstock, beyond the new ore body alluded to, a striking departure from established analogy is observed. Experience on the Comstock has always shown that wherever the vein itself presented large quantities of porphyries imbedded in its matrix, large deposits of quartz were sure to be found at the termini of these intruded masses; and that wherever large quartz-bodies were met, there we were sure to find ore also. Now, developments in Bullion, Imperial, and Crownpoint, from a depth of 1,000 feet to 1,400 feet, have proved the existence of large quartz bodies. The Bullion, at 1,200 feet, shows 63 feet quartz-width; the Imperial 1,000-foot level shows 50 feet quartz and over 87 feet quartzose matter; the Crownpoint 1,000-foot and 1,100-foot levels show from 20 to 60 feet width of quartzose matter; yet in neither mine, in the ground rerred to, has ore been found in more than traces. These quartz bodies, d the porphyries accompanying them, show carbonate and sulphate lime, which neither contained at the upper levels. The waters met th, since limestone made its appearance and the porphyry became so ll of pyrites, have been hot—120° Fahrenheit on June 28 in Crown- int 1,100-foot level; and ore has never yet been found in paying bodies this vein where hot water was encountered. The first example of this le was furnished five years ago in the North Comstock. The Central mpany's shaft had attained a depth of 562 feet—162 feet below the rminus of the ore—and hot water was encountered, preventing further plorations. Since that time the Ophir has explored over 400 feet eper, with a level, and found nothing but limestone and pyrites.

The impression I received last year has not been removed by the story of the present year. All the observed phenomena appear to in- cate that the present deepest workings of the Comstock mines are in comparatively barren zone of the vein, which seems, moreover, to be aracterized by a change in the gangue from predominant quartz to edominant carbonate and sulphate of lime. Whether this gradual riation in the gangue is in any way the cause of the diminution of ore, merely an accidental coincidence, I shall not discuss. The discussion ould require the proposition and defense of some particular theory of e processes of the vein formation, which I do not desire to undertake, d an investigation of chemical as well as geological character, for hich the facts are not yet sufficient. I must confess, however, that I cline, aside from theoretical reasoning, to believe the appearance of ne in the vein to be connected directly with a change in its metallifer- us character. Not that it has prevented the occurrence of ore in depth; t that the character of the ore and its distribution will be found to ange if the lime continues. It is quite natural—that is to say, quite common phenomenon—that the zone between two sorts of gangue ould be comparatively barren; and this appearance need not discour- ge the expectation of finding new metalliferous deposits below it. With gard to the important question, how extensive this zone may be, of urse it would be folly to attempt a definite answer, yet the following ggestions may be of value:

1. The barren zone now penetrated by the deeper workings on the mstock is either one of transition or one of temporary variation. The artzose gangue has by no means disappeared; it only threatens to do , or at least to become permanently subordinate. The lime, on the her hand, threatens to become permanently predominant, and has us far proved unfavorable to the occurrence of ore in the forms and mbinations hitherto characteristic of the vein. In this mixed condi- n of things, the vein matter being neither one thing nor the other, it not surprising that the proportion of ore is so greatly diminished. ithout meaning to commit myself to any elaborate theory, I may say, the purpose of illustration, that the calcareous minerals are, as it re, themselves playing the part of ore to the quartz.

2. We may reasonably expect one of two things. Either the unpleas- t admixture of lime will prove to be local and temporary, and the in will resume again in depth its original matrix, or the change now reatened will continue until the carbonate and sulphate of lime are rmanently predominant as gangue.

3. In the former case the chances are in favor of a briefer continuance the barren interval, and of a subsequent recurrence of ore bodies simi- r in character and distribution to those already exploited. In favor this supposition we have the universal prevalence of quartz as vein

material through our silver-bearing regions, and the comparatively infrequent appearance in large quantities, under such conditions, of the carbonate or sulphate of lime. Moreover, there has not been observed, so far as I know, any decided change in the country rock, such as might be expected (though not of absolute necessity) to herald or accompany a complete change in gangue. Again, there is some encouragement for this view, in the fact that the vein of the Occidental and other mines, lying a mile and a half or two miles east of the Comstock, contains in its south portion heavy layers of lime rock, which yield in depth to quartz. (See my former report, p. 50.) This fact has perhaps the more significance, since we may probably look to the east for the principal sources of the materials filling the Comstock lode.

4. In case of the complete change of the gangue and the permanent prevalence of lime, the character of the ores and the manner of their distribution would probably suffer a complete change also. As a mere illustration, I may say that the ores in depth would have to bear the same relation to lime that the present ores bear to quartz. This relation science cannot now exactly define; it is surmised to be partly chemical, partly electrical, and partly mechanical; and it is certainly dependent also upon the manner in which the vein-fissure was filled, and the succession and relative duration of the different entrances of vein-matter. The nature of the ore that might be expected in a lime gangue on the Comstock is, however, practically indicated by the modifications already observed in those parts of the vein where lime forms a considerable proportion of the gangue; and judging from this hint we might anticipate more widely disseminated ore, of lower grade, containing more base metal and more difficult of treatment than has been the case in general heretofore.

It is impossible to predict which of the two contingencies thus described will arise. With regard to the latter it may be said that the analogies of other veins in the neighborhood, or even in the whole silver belt of the United States, afford no argument, since none of them are opened to such a depth. The probability of the change alluded to will increase with every new depth attained in working on the barren zone.

5. The most difficult and costly labor on this vein has always been, and is now more than ever, the exploration of the vein for new bodies of ore; and the expense of this necessary work has increased with increasing depth until it is now crushing. The reduction in milling rates affords no relief to those companies which have no ores to be milled, though it will enable work to be prosecuted in many cases where formerly the high cost of treatment prevented the extraction of low-grade ores. The present crying necessity is a cheapening of the mine expenses. The Virginia and Truckee railroad, by reducing the prices of timber, and to some extent of supplies, has effected a considerable improvement; but much remains to be done before the explorations in depth can be economically carried on to the extent which the circumstances encourage and demand.

Foremost among the necessary reforms is the consolidation of companies, and the consequent reduction of the cost of administration. This movement is already beginning among the small proprietorships, and by another year I expect to find the aggregate number of companies on the vein greatly reduced.

The systems of ventilation by machinery, of drainage by pumps, and of hoisting through vertical shafts, though great improvements on the ruder methods of natural ventilation, (or no ventilation,) hoisting water in buckets, and dragging out ore through inclines, are, nevertheless, fast approaching their economical limit of application in these mines. In a foot note to my previous report, (page 52,) I pointed out the great advantage of utilizing the enormous "head" afforded by the depth of the shafts, in the employment of hydraulic power. This is not possible until an outlet is created below for the water so employed; and this consideration alone renders the construction of a deep tunnel an economical necessity. It is reported that operations have been commenced on the Sutro Tunnel, and that the laboring miners themselves have subscribed a large sum, "as a first installment," toward the enterprise. Whoever builds this tunnel, it seems to be of vital importance to the industry of mining on the Comstock that it should be completed. The calculation, quoted in my last report, that fifty gallons of water per second, with a fall of two thousand feet, create a working capacity of 1,800 horse-power, is slightly exaggerated, as the power thus created would be more exactly 1,516 horse-power;* but the fact remains as a forcible argument, justifying my assertion that "if the Sutro Tunnel is completed to the lode, and connected with deep shafts, the conditions for explorations to still greater depths will be more favorable than they were at the very surface; since the immense power of the hydraulic column will be at the service of the miner."

MINES ON THE CONTINUATIONS OF THE COMSTOCK.

So many of the Comstock mines proper have been compelled to extract from their old workings ores once cast aside, as not worth enough to pay for treatment, that the mills, as well as the mines, have found their advantage in reducing the prices of custom-work, to enable these operations to be continued; and this reduction of prices has in turn caused the resumption of active work on many a mining claim beyond the limits of the recognized Comstock ledge, though on the extensions north and south of its supposed course. South of the Overmann are three or four claims which have lain idle for years. Under the present favorably low milling rates, ore is extracted from them on contract by small companies of miners. It is principally found near the surface, contains a comparatively large proportion of gold, and yields from $11 to $14 a ton. The amount thus obtained is, however, quite limited. North of the Utah, work has been done for some time on small claims; and, it is said, with profit. There are a good many places on nd around the Comstock lodes where it would not pay a large company o operate, but where small associations of miners, not burdened with ostly organizations and administrations, can labor with profit.

The Sacramento mine appears to occupy the northern continuation of he Comstock; and in this mine a larger amount of work has been perormed than in any other of the similar locations coming under this ead. The ores run as high as $20 per ton, and may be called, on the verage, twelve-dollar mill rock; the mean production is 50 tons per day.

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*A gallon of water contains 231 inches, and weighs 8.3388822 avoirdupois pounds. o compute the power of a fall of water, it is necessary to multiply the amount in ounds falling per minute, by the height in feet through which it falls. The product the number of foot-pounds per minute exerted by the fall. As 33,000 foot-pounds per inute constitute one horse-power, it is easy to obtain the number of horse-powers. hus:

$\frac{0\times60\times8.3388822\times2000}{33,000}=$1,516.16 horse-powers, exerted by the column of water in mo-
ion as above supposed.

PRODUCING MINES OUTSIDE OF THE COMSTOCK.

West of the Comstock, very little prospecting work has been done during the year. The explorations of former seasons, upon the small parallel quartz veins in the syenite of the west wall, were not encouraging in their results, and have not been, to any considerable extent, renewed or continued.

On the contact vein to the eastward, (see last year's report, page 50,) operations have been successfully prosecuted, especially since the reduction of milling rates. The aggregate length of the locations on this vein amounts to three miles; but only four or five of the claims have been worked of late with vigor: The principal mines are the Occidental, St. George, Lady Bryan, Monte Christo, and Flowery. All of these, and especially the Occidental and Flowery, contain a large amount of low-grade ore. The ground of the Occidental has been explored to the depth of nearly seven hundred feet, yielding low-grade ore (average $14) all the way down. The lower tunnel (referred to in my last report, page 50) has reached the vein 863 feet below the outcrop and given evidence that the ore is continuous in depth. The company has the promise, in the ground already opened, of eighteen months or two years of lucrative activity.

The Flowery mine has only recently (*i. e.*, during the summer) become the scene of renewed operations. The ores vary from $10 to $28 in value per ton, and are easy of reduction by the Washoe process. The principal matrix of the vein in this mine is quartz, while the southern part, especially in the Occidental, shows predominant lime.

The contact vein upon which these mines are situated will undoubtedly yield much more ore and bullion than has heretofore been expected of it. The extended and healthy activity here springing up is a proof of the wisdom of reducing the custom rates at the mills, without which measure these mines could not have been worked. Now that the completion of the railroad to Carson is carrying in that direction the Comstock ores, the mills in and about Virginia, which would otherwise be left without employment, find in these mines fortunate sources of supply already open.

Estimate of cost of mining and reducing ores in Virginia district, Storey County, Nevada, July 1, 1869.

Wages of first-class miners: Four dollars for eight hours' work.

Wages of second-class miners: Three dollars and fifty cents for eight hours' work.

Wages of surface laborers: Three dollars to three dollars and fifty cents for ten hours' work.

Cost of lumber: Common boards, three and one-half cents per foot.

Cost of mining timber: Hewed, thirty dollars per thousand feet; sawed, twenty-eight dollars per thousand feet; planking, twenty-seven dollars.

Cost of common powder: Three to four cents per pound.

Cost of giant powder: One dollar and fifty cents per pound.

Cost of quicksilver: Sixty-three cents per pound.

Cost of freight from Rheno to Virginia: From sixty to seventy-five cents per hundred pounds, in summer; from eighty-seven cents to one dollar and twelve cents, in winter.

Cost of fuel: Nut pine, sixteen to seventeen dollars; cedar, eight to eleven dollars in Virginia; (cost in Gold Hill is a trifle less;) yellow pine, from fourteen to fifteen dollars per cord.

Cost of ten-stamp mill, including freight and erection: Thirty-five thousand dollars.*

Cost of twenty-stamp mill, including freight and erection: Sixty thousand dollars.*

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* California pattern does not exist here, because California pattern has no pans. The above estimate is made for pan-amalgamation and taken from actual figures of costs.

Minimum mining cost per ton of ore: Three dollars and seventy-six cents.

Mine from which this is reported: Chollar Potosi mine.

Character of rock at that mine: Blasting rock mostly, (silver and gold.)

Depth of mine: Deepest ore extracted is three hundred and sixty feet; mostly two hundred and sixty feet deep and less; while the depth of new shaft is one thousand two hundred and twenty-five feet.

Maximum mining cost per ton, (accessory work included:) Eleven dollars and sixteen nts, (as near as can be ascertained.)

Mine from which this is reported: Yellow Jacket.

Character of rock: Easy of extraction, not requiring powder.

Depth of mine: Nine hundred feet.

Minimum reduction cost: Seven dollars and sixteen cents; also, two dollars and elve cents per ton.

Name of mill, number of stamps: Savage mill, thirty stamps; Sierra Nevada, fifteen amps.

Character of process employed: Wet-crushing and pan-amalgamation; wet-crushing, malgamation in battery riffles, blankets, no pans.

Maximum milling cost: Eleven dollars and eighty-two cents.

Name of mill, and number of stamps: Rhode Island, twenty stamps.

Character of process employed: Wet-crushing and pan-amalgamation.

Average mining cost per ton: In the whole district, six dollars and fifty cents per on.

Average milling cost per ton: Eight dollars in the whole district for pan-amalgaation.

Average pulp assay of ore of the whole district: Forty dollars, (as close as can be certained.)

Average yield of ore: Sixty-eight per cent. of the fire assay.

Remarks.—The Union Mill and Mining Company crushed 170,378.682 tons of ore, at cost of nine dollars and sixteen cents per ton, including all repairs and accessory ork.

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llion product of Virginia mining district, Storey County, Nevada, for the year from July, 1868, to July, 1869.

Date.	Virginia.	Gold Hill.	Virginia and Gold Hill.
68—July	$661, 387 80	$631, 183 72	$8, 778 67
August	537, 205 50	624, 966 93	62, 775 92
September	523, 999 35	470, 065 61	119, 640 90
October	585, 317 45	263, 730 61	126, 547 76
November	614, 659 37	221, 707 42	130, 822 36
December	60, 145 68	271, 448 73	127, 609 02
69—January	553, 807 39	285, 648 53	93, 150 40
February	759, 988 87	229, 251 55	66, 160 64
March	600, 482 16	231, 049 87	121, 539 92
April	628, 177 08	150, 217 35	246, 697 89
May	449, 425 50	72, 605 81	230, 829 78
June	421, 792 41	68, 922 93	292, 476 79
Total	*6, 396, 388 56	*3, 520, 799 06	†1, 627, 039 13

Making a total of $11,544,266 75.

* By Wells, Fargo & Co.'s Express. † By Union Pacific Express.

Annual statement of the Sierra Nevada, January 1, 1870.

Statement of profits:

ividends paid	$45, 000 00
ld indebtedness	19, 626 39
w boilers and engines	4, 965 44
sh on hand	485 50
Total	70, 077 33

Deduct:		
Cash on hand January 13, 1869	$669 94	
Present indebtedness	16,457 10	
		$17,1
Net profit		52,9
The receipts from all sources were		$155,9
Amount of ore crushed ... tons		1
Average yield per ton		$
Mine expenses per ton	$1 92	
Mill expenses per ton	3 03	
Other expenses per ton	77	
Profit per ton		

or 34 per cent.

Annual statement of the Ophir, December 15, 1869.

Receipts:	
Ophir reduction works	$12,07
Woodworth mill	13,15
Balance collected on assessment No. 8	18,93
Assessment No. 9	50,40
Assessment No. 10	50,40
Amount collected on assessment No. 11	30,81
Miscellaneous	11,80
Balance on hand, December 16, 1868	22,6
Total	210,27

Disbursements:	
General expenses at mine	$7,7
Buck's shaft construction	82,4
Buck's shaft machinery	48,05
McDonald & Whitney, (compromising suit)	19,9
Virginia and Truckee railroad, (advanced)	25,0
Miscellaneous	18,6
Cash on hand, December 15, 1869	8,4
Total	210,27

During the year 143 feet of shaft were sunk and about 1,000 feet of drift run.

Annual statement of the Gould & Curry, November 30, 1869.

Receipts:	
Bullion from 9,412 tons of ore	$247,58
Sale of sluices, tailings, &c	32,35
Sale of 6,149 tons of ore	6,39
Assessment No. 6	72,00
From Reservoir mill	26,31
Material sold, rents, &c	7,153
Superintendent's balance account	7,106
Miscellaneous items	3,44
Overdrawn on treasurer	22,87
Cash on hand	51
Total	425,291

Disbursements:

indebtedness November 30, 1868	$38,822 09
payable	3,875 00
rance on D street works	1,470 2
r at mine	132,536 33
rials for mine	70,512 40
account	4,858 80
s, State and county	6,117 37
rse claims and legal expenses	8,785 55
ral expenditures; salaries of officers	16,057 6
icing ore at custom mills	101,980 88
inia and Truckee railroad	40,090 00
ellaneous	5,274 70
Total	425,291 04

e total assets of the company aggregate $322,392, against which there are liabili-
mounting to $45,325.

Annual statement of the Savage, July 1, 1869.

Receipts:

on product	$1,949,925
ium on same	4,875
sold	15,919
gs, &c	6,323
on hand July 1, 1868	106,320
Total	2,083,362

Disbursements:

ends	$751,575
tion of ores, custom mills	552,836
tion of ores, company's mills	145,447
	284,769
es of officers	20,022
nia and Truckee railroad	75,000
r and lumber	50,549
wood and coal	53,636
ware, candles, &c	26,025
ing	10,839
	19,520
ies	45,749
on hand, July 1, 1863	47,395
Total	2,083,362

hundred and fifty thousand dollars was subscribed toward the completion of the
nia and Truckee railroad. The amount of ore on hand at the mine, July 1, 1868,
683, and on July 1, 1869, 121 tons. The ore reduced during the year amounted to
tons. The amount of ore sold was 15,368 tons. The cost of production and re-
n, yield and profit of the ore reduced during the past year compares as follows
he two preceding years:

Years.	Production.	Reduction.	Total.	Yield.	Profit.
67	$7 91	$14 04	$21 95	$41 94	$19 99
68	7 21	13 74	20 95	40 84	19 89
69	8 90	12 22	21 12	34 87	13 75

amount of ore reduced in 1866–'67, was 69,377 tons; in 1867–'68, 84,627 tons, and in 1868–'69, 55,479 tons. The receipts and disbursements for the past three fiscal years compare as follows:

Years.	Receipts.	Disbursements.	Cash on hand.
1866–1867	$2,935,875	$2,898,183	$77,716
1867–1868	3,530,834	3,502,230	106,320
1868–1869	1,977,042	2,035,967	47,395

The monthly dividends disbursed by the company for the same years were as follows: In 1866–'67, $880,000; in 1867–'68, $1,560,000; in 1868–'69, $968,000. From date of organization the amount of ore taken from the mine has been 339,808 tons; reduced, 324,317 tons; gross receipts in bullion and from ore sold, $13,304,740; assessments levied, $188,000; and dividends disbursed, $4,528,000. The available assets of the company at the close of the fiscal year were $90,803, against liabilities, $2,655. The property assets of the company aggregate $256,000, as follows: Savage and Atchison mills, $90,000; E street shaft and works, $150,000; buildings at Virginia and assay office, $16,000.

Annual statement of the Hale & Norcross, March 1, 1869.

The following is taken from the secretary's statement:

Receipts:	
Cash on hand February 29, 1868	$3,918 18
From assessments	201,960 00
Bullion and ores sold	395,691 77
Fair shaft account—transfer of materials to mine account	19,542 35
Cash for amount of overdraft at Bank of California	4,637 00
Sundries	4,720 21
Total	630,469 51

Disbursements:	
Mine account	$275,286 79
Ore account—reduction	216,775 47
Machinery account	9,345 55
Fair shaft account	12,278 90
Salary account	13,100 00
Bank of California	61,784 72
Bills payable	7,283 08
Sundries	34,477 26
Cash on hand	137 74
Total	630,469 51

The expense of reducing 16,535½ tons of ore amounted to $13 11 per ton. During 1866 the bullion yield aggregated $1,355,220, equal to $47 32 per ton; in 1867, $864,998, equal to $34 14 per ton; in 1868, $395,146, equal to $23 89 per ton. The statement shows an excess of assets over liabilities amounting to $218,981 51. Assessment No. 34, of $5, has been rescinded.

Annual statement of the Chollar Potosi, June 1, 1869.

The company extracted during the year 44,900 tons of ore, giving an average yield of $23 70 per ton. The cost of extraction, reduction, &c., was $21 09; leaving a net profit of $2 61 per ton.

The following is the secretary's statement.

Receipts:	
Bullion	$1,152,303 37
Ores sold	29,989 33
Premium on bullion	2,849 22
Superintendent's account	3,074 37
Sundries	2,845 50
Cash on hand per last statement	110,148 35
Total	1,301,210 14

xpenditures:

d	$41,595	00
	238,663	00
re, &c	34,414	34
and lumber	36,036	06
od	18,953	49
g ore	636,878	27
nd legal expenses	9,138	01
e railroad	75,000	00
	7,213	43
g	3,047	12
ls	6,193	87
s	25,086	20
hand	168,991	35
Total	1,301,210	14

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nnual statement of the Empire Mill and Mining Company, November 30, 1869.

uantity of ore taken out during the past year has been light, amounting to
ns, while the amount reduced was 9,714 tons, yielding bullion to the value of
. The total receipts were about $187,000.

eceipts:

per report November 30, 1868	$13,115	26
	153,554	11
hips and premium	613	04
nent	30,000	00
aneous	3,307	07
ties, &c., November 30, 1869	24,478	21
Total	225,067	69

isbursements:

edness, November 30, 1868	$26,794	42
count	95,038	42
ccount	56,025	58
aft	21,155	03
aneous	21,344	03
November 30, 1869	4,709	25
Total	225,067	69

assessment mentioned above is the first levied. The company have paid no
ds since May, 1867. Of the $95,000 disbursed on mill account, $33,640 were for
9,678 for labor, and $11,972 for machinery; while of the $56,000 paid out on
ccount, $28,187 were for labor. The operations at the mine for the year embraced
ning of 1,600 feet of drifts and winzes.

Annual statement of the Imperial, June 1, 1869.

the superintendent's report we learn that there are yet about 7,000 tons of ore on
-foot and 700-foot levels in the Alta mine. The work done in this mine during
t year consists of the running of 210 linear feet of drifts; the running of 250 feet
ze; retimbering of 60 feet of shaft, and the extracting of 41,000 tons of ore.
Holmes mine about 100 tons of croppings per month are mined. The work done
Imperial Empire shaft embraces the sinking of 225 feet of shaft, and the running
linear feet of drifts. The developments in connection therewith have been un-
ctory. The Rock Point and Gold Hill mills had been repaired and were in good
on. The Lindaur mill was still closed. The value of the supplies on hand at
ne was $12,613. The president's report states that measures have been taken to
a title by patent, from the State of Nevada, to the site of the Rock Point mill,
ch event it was expected that the company's title to the mill-site would be fully

established. The secretary's report shows the receipts to have been (including ca hand and book account) $775,027. We annex the leading items:

Receipts:

Alta mine—ores worked at company's mine	$57
Hoisting ores	1
Holmes mine—ores worked at Gold Hill mill	2
Rock Point mill—sundries	1
Gold Hill mill—sundries	
Premium account	
Assessment No. 2	10
Miscellaneous items	1
Cash on hand May 31, 1869	3
Total	77

The expenditures had been $763,167, leaving a balance on hand of $11,860. principal disbursements were as follows:

Expenditures:

Expenses in San Francisco	$
Imperial new drifts	2
Gold Hill mill	9
Rock Point mill	2
Alta mine	21
Holmes mine	
Imperial Empire shaft	7
Dividend	2
Miscellaneous items	4
Assets May 31, ($7,680 cash)	1
Total	77

The ore statement for the year shows the average yield to have been as follows: mine, 42,958 tons of ore, worked at an average per ton of $13 37; Holmes mine, tons of ore, worked at an average per ton of $11 64. The average cost of extra 40,975 tons of ore from the Holmes mine was $4 78½ per ton. The average cost of ing 12,333 tons of ore at the Gold Hill mill (less supplies on hand, amounting to $ was $7 84; while the average cost of working 32,839 tons of ore at the Rock Point (less supplies on hand, amounting to $5,904) was $7 80⅝ per ton. The bullion ment for the year shows a value of $603,146.

Following is a statement of the total disbursements and receipts of the company the date of incorporation to May 31, 1869:

Disbursements:

Milling, mining, machinery, improvements	$3, 81
General expenses, legal fees, &c	28
Assaying	3
Expenses in San Francisco	5
Interest	1
Premium and discount	2
Treasure freight	3
Federal tax, paid assayer	1
Dividends	1, 03
Assets (including $7,680 cash)	1
Total	5, 36

Receipts:

Ores and sundries, account mine and mills	$5, 11
Proceeds outside ore	4
Assessment	1
Miscellaneous	4
Total	5, 3

The available assets of the company, in supplies, amount to $12,613. The onl standing liability of the company is $27,000, due Virginia and Truckee Railroad pany, being balance of subscription, ($30,000,) payable in monthly equal install of $3,000.

Annual statement of the Yellow Jacket, July 1, 1869.

eceipts:

e per last report	$49,249 13
	1,761,313 69
d	18,693 62
mill profits	109,982 88
nent No. 7 overpaid	200 00
nent No. 11 overpaid	530 00
g ore for Kentuck Company	5,027 49
aneous	19,452 89
Total	1,964,449 70
e at company's debit	251,007 89
Total	2,215,457 59

isbursements:

	$277,288 45
pplies	56,922 21
ement No. 1, central works	3,838 43
ement No. 2, south hoisting works	30,834 28
xpenses	10,717 00
es, revenue stamps, &c	7,937 98
s and oil	11,683 33
and fuse	3,754 20
	64,080 87
d steel	4,543 93
	65,327 82
g ore, outside mills	514,311 86
g ore, company's mills	332,600 64
discount on bars, and federal tax	31,687 23
tate for mining purposes	6,345 00
t	12,809 18
of officers	17,167 00
ffice	2,771 99
g tailings, company's mills	34,583 79
ay joint account	1,869 87
nd loss, Mexican mill, &c	3,399 82
nnel expenditure	982 48
Total	2,215,457 59

ssets and liabilities of the company are shown by the following statement:

ssets:

upplies on hand	$10,282 50
ents Nos. 1—11	412 50
open ledger accounts	678 57
Total	11,373 57
at company's debit	251,007 89
Total	262,381 46

iabilities:

accounts	$11,822 26
e due Bank of California	250,559 20
Total	262,381 46

Annual statement of the Kentuck, November 1, 1869.

SECRETARY'S STATEMENT.

eceipts:

hand November 1, 1868	$38,825 28
product	805,732 82

Premium on bullion	$963 84
Assessments Nos. 1 and 2	40,000 00
Total	885,521 94

Disbursements:

Reduction of ores	$374,995 45
Labor	139,095 55
Dividends Nos. 27 and 28	100,000 00
Advance to Virginia and Truckee railroad	75,000 00
Timber account	21,265 01
Hoisting ores	12,381 48
Mine supplies	12,020 63
Sundry accounts	70,883 28
Cash on hand November 1, 1869	79,880 54
Total	885,521 94

From the superintendent's report the following comparative table is added:

Year.	Ore yield—tons.	Gross yield.	Net yield.	Yield per ton.	Cost of production and reduction.	Net profit.
1868	31,390	$1,257,563 85	$515,043 13	$40 06	$23 65	$16 41
1869	27,876	804,732 82	178,531 70	28 88	22 47	6 41

"The poor exhibit of the present year," continues the superintendent, "as compared with the results of the previous year, is mainly, if not solely, attributable to the great fire which occurred in the mine on the 7th of April last, which for nearly five months caused an entire suspension of work in the principal ore-bearing localities. In the mean time all possible efforts were made, by means of air-drifts and winzes, and powerful air-blasts from the surface, to reach the ore-bodies on the 800-foot and 900-foot levels, which on the 20th of August last we succeeded in doing, and commenced extracting ore; and since that time have extracted, on an average, 130 tons of ore per day."

During the fiscal year 27,867 tons of ore were extracted—the Old West ledge, between the 400-foot and 200-foot levels, yielding 6,667 tons, and the East ledge, as follows: Between 700-foot and 550-foot levels, 9,500 tons; 800-foot and 700-foot levels, 10,750 tons; and 900-foot and 800-foot levels, 950 tons.

Annual statement of the Crownpoint, May 1, 1869.

During the fiscal year, May 1, 1868, to May 1, 1869, 26,734 tons of ore were extracted—13,292 tons coming from the 800-foot level. The shaft has been carried to a depth of 300 feet, from the 800-foot to the 1,100-foot level.

Receipts:

Bullion product	$849,479
Sale of tailings	15,061
Assessment	90,000
Miscellaneous items	18,187
Cash in treasury May 1, 1868	127,683
Total	1,100,410

Disbursements:

Crownpoint mine, labor and supplies	$287,853
Mine improvements	9,265
Working 25,833 tons ore	321,668
Legal expenses	4,815

	$10,229
ing	7,555
al expenses Gold Hill and San Francisco offices	28,045
nia and Truckee railroad subscription	18,750
ends to stockholders	300,000
llaneous items	9,550
in treasury May 1, 1869	42,680
Total	1,100,410

ore statement for the past year shows that 25,832½ tons were reduced, yielding 27, or an average of $32 73 per ton, as follows:

Mills.	Tons.	Average.	Amount.
Island mill	17,685	$30 93	$546,959
mills	8,148	36 54	297,641
grains			1,027
'otal	25,833	32 73	845,627

average cost of working the ore for the past year was $11 66, and for mining making a total cost of $21 46 per ton. The assets of the company on the 1st of ere as follows:

Assets:

n hand May 1, 1869	$42,679 76
Island mill	60,000 00
mprovements, buildings, &c	80,000 00
on hand at mine	33,282 38
on hand at mill	27,909 74
ic and Pacific States Telegraph Company	493 75
ia and Truckee railroad	18,750 00
Total	263,115 63

only liability against the company May 1, 1869, was $56,250, being balance of iption ($75,000) to the Virginia and Truckee Railroad Company.

annual ore statements for the past five years compare as follows:

Years.	Tons worked.	Milling per ton.	Yield per ton.	Mining per ton.
5	3,766	$20 00	$36 60	$15 00
6	18,258	15 09	37 73	8 87
7	34,750	14 97	35 91	7 50
8	25,964	13 36	33 35	9 85
9	25,833	11 66	32 73	9 80

Annual statement of the Overman, July 1, 1869.

Receipts:

a	$358,863
ld	5,039
ments	140,260
ranch account	28,678
es	5,446
n hand July 1, 1868	52,184
Total	590,470

Disbursements:

Reducing ores	$290,936
Labor account	117,005
Wood-ranch account	61,416
Lumber, &c	66,105
Salaries	8,321
Sundries	38,655
Cash on hand July 1, 1869	8,032
Total	590,470

The average yield of 22,261 tons of ore, reduced during the fiscal year, was $16 12 per ton.

Annual statement of the Gold Hill Quartz, January 1, 1870.

Gross receipts during the year	$98,449 66
Disbursements	90,258 72
Surplus	8,190 94

Of which $726 35 is in cash, and the balance in supplies and in debts due. The liabilities amount to $5,658. One assessment of $20 per share, or $10,000, was levied on the 13th of May. No dividends have been paid during the year. At the beginning of the year there were 339 tons of ore on the dumps, and the quantity crushed was 3,776 tons, leaving 30 tons on hand at the close. From the above ore the following quantities and values of bullion were produced:

33,127.70 ounces gold and silver	$64,515 30
377.72 ounces assay grains	691 23
Total	65,206 53

Of the bullion, $27,785 was gold and $36,730 silver.

bullion product, assessments, and dividends disbursed during the year 1869, *regarding ns on the Comstock, together with totals for* 1866, 1867, *and* 1868, *during the same*

pany.	January.			February.			March.		
	Bullion.	Assessments.	Dividends.	Bullion.	Assessments.	Dividends.	Bullion.	Assessments.	Dividends.
								$31,200	
								25,000	
t	$38,458			$21,602			$33,070		
	10,960						7,929		
tosi	50,700			74,869			110,392		
		$16,000						$20,000	
& M. Co.	13,665			15,737			18,217		
.M.& M.Co	6,956			5,169			5,576		
urry							7,500		
rcross							60,465		
	46,728			38,070			38,882		
	83,335		$40,000	54,014			63,739		
	40,000			40,000			40,000		$20,000
	36,000			11,000			25,170	64,000	
Belcher				2,024			2,815		
	176,700		64,000	174,300		$40,000	173,817		64,000
ada	9,998			3,728			19,300		
ket	160,000		120,000	160,000		120,000	160,000		120.00
n 1869	673,500	16,000	224,000	600,513		160,000	766,872	140,200	204,000
n 1868*	411,016	294,900	110,000	431,333	$186.000	110,000	711,697	76,600	90,000
n 1867	1,022,377	110,000	294,000	1,014,238	76.000	276,000	728,916	44,480	280,000
n 1866	671,555	62,000	60,000	803,161	299,000		817,177	113,600	30,000

any.	April.			May.			June.		
	Bullion.	Assessments.	Dividends.	Bullion.	Assessments.	Dividends.	Bullion.	Assessments.	Dividends.
								$30,000	
	$8,280				$50,000				
	12,588								
					31,200				
osi	122,593			$131,383			$175,700		42,000
					12,000				
& M. Co	16,400			14,618			15,277		
urry							46,296		
M.& M.Co	4,969			5,601	10,000		6,074		
rcross	113,652			152,894		48,000	120,500		48,000
	37,888			42,993			26,386		
	18,429						24,255	20,000	
	30,000			15,000			15,000		
					50,400				
	32,527			30,516	64,000		21,458		
Belcher									
	173,900		$64,000	155,000			89,500		48,000
ada	13,888			21,870			19,381		7,500
ket*	150,000						50,000		
n 1869	735,114		64,000	569,875	219,600	48,000	609,827	30,000	145,500
n 1868*	756,638	$54,000	100,000	860,640	202,400	180,000	843,191	97,200	317,750
n 1867	1,262,937	31,600	283,000	1,599,797	25,000	460,200	1,436,388	153,300	475,000
n 1866	781,362	140,000	164,000	852,569	44,800	108,000	1,000,884	28,000	164,000

hly returns of bullion from Yellow Jacket are included in the monthly totals of 1868, while of the mine is estimated in the monthly reports of 1869.

Table of bullion product, assessments levied, and dividends, &c.—Continued.

Company.	July.			August.			September.		
	Bullion.	Assessments.	Dividends.	Bullion.	Assessments.	Dividends.	Bullion.	Assessments.	Dividends.
Alpha									
Belcher							$10, 030		
Bullion					$25, 000				
Crownpoint					60, 000				
Confidence									
Chollar Potosi	$162, 650		$56, 000	$149, 397		$56, 000	116, 667		$56, 000
Daney					8, 000				
Empire M. & M. Co	13, 579			12, 812			10, 218	$30, 000	
Gould & Curry	36, 217			35, 229			44, 344		
Gold Hill Q.M.&M.Co	7, 137			7, 564			7, 821		
Hale & Norcross	105, 345		48, 000	79, 507			80, 907		
Imperial	13, 789	$20, 000		14, 355			14, 636	40, 000	
Kentuck	17, 374			75, 764	20, 000		138, 349		
Occidental	10, 000			10, 000			10, 000		
Ophir		50, 400							
Overmann	24, 000			30, 000			12, 500		
Segregated Belcher					6, 400				
Savage	51, 000			32, 645			41, 800		
Sierra Nevada	16, 661		7, 500	12, 697		7, 500	12, 666		7, 500
Yellow Jacket	100, 000	240, 000		150, 000			180, 000		
Total in 1869	557, 752	310, 400	111, 500	609, 970	119, 400	63, 500	679, 940	70, 000	63, 500
Total in 1868*	794, 240	197, 000	383, 750	713, 735	25, 000	280, 000	589, 166	30, 000	200, 000
Total in 1867	1, 379, 116	108, 570	577, 500	1, 306, 549	6, 400	447, 500	1, 171, 327	258, 000	370, 000
Total in 1866	939, 605	80, 800	154, 000	1, 106, 896	75, 000	154, 000	1, 054, 011		174, 000

Company.	October.			November.			December.		
	Bullion.	Assessments.	Dividends.	Bullion.	Assessments.	Dividends.	Bullion.	Assessments.	Dividends.
Alpha									
Belcher		$26, 000							
Bullion					$17, 500				
Crownpoint		90, 000							
Confidence									
Chollar Potosi	$108, 070		$28, 000	$87, 580		$28, 000	$76, 184		$28, 000
Daney		8, 000						$8, 000	
Empire M. & M. Co	7, 523								
Gould & Curry	28, 933			31, 823			28, 048		
Gold Hill Q.M.& M.Co	2, 629						5, 711		
Hale & Norcross	110, 116			79, 264			127, 162		
Imperial					40, 000				
Kentuck	143, 381			145, 194		20, 000	65, 000		20, 000
Occidental									
Ophir		33, 600							
Overmann	12, 820			55, 691			44, 803		
Segregated Belcher		6, 400							
Savage	31, 271			31, 200			31, 670		
Sierra Nevada	16, 100		7, 500	5, 071		7, 500			
Yellow Jacket	150, 000			150, 000	120, 000		150, 000		
Total in 1869	610, 843	164, 000	35, 500	585, 823	177, 500	55, 500	528, 578	8, 000	48, 000
Total in 1868*	535, 164	106, 000	120, 000	493, 725	144, 400	400, 000	559, 224	413, 000	124, 000
Total in 1867	1, 079, 799	205, 000	240, 000	894, 120	132, 000	135, 000	646, 628	145, 600	153, 750
Total in 1866	1, 032, 713	164, 620	167, 2[illegible]0	1, 040, 172	134, 000	229, 000	1, 039, 537	128, 000	370, 000

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* No monthly returns of bullion from Yellow Jacket are included in the monthly totals of 1868, while the product of the mine is estimated in the monthly reports of 1869.

f bullion product, dividends, and assessments of claims on the Comstock lode for
ther with the aggregate figures concerning the same for the years 1868, 1867, *and*

Company.	Bullion product.	Dividends.	Assessments.
			$30,000
			34,800
	$18,312		109,200
			67,500
	105,718		150,000
	18,889		31,200
i.	1,366,185	$294,000	
			4,500
Virginia			52,200
			72,000
nd Mining Company	138,046		30,000
y	258,390		
rtz Mill and Mining Company	65,207		10,000
oss	1,029,812	96,000	
	273,727		100,000
			30,000
			22,500
	828,834	80,000	40,000
	210,000	20,000	
			134,400
	336,485		128,000
elcher	4,839		12,800
	1,162,803	280,000	
a	151,360	45,000	
t*	1,560,000	360,000	360,000
1869	7,528,607	1,175,000	1,419,100
1868	8,499,769	2,415,500	1,825,500
1867	13,626,062	3,991,950	1,296,250
1866	11,732,100	1,754,400	1,194,820

* Bullion estimated.

yield of bullion in the State of Nevada since the discovery of the Comstock lode.
By C. B. Dahlgren, Esq.

Year.	Bullion.	Section derived from.
	$93,872,500	Comstock chiefly, Esmeralda, Reese River, Ione.
	16,172,000	Comstock, Reese River, Belmont.
	13,317,500	Comstock, Reese River, White Pine.
	14,000,000	Comstock, Reese River, White Pine.
	137,382,000	

Stamp mills of Nevada in 1869.

Names of counties.	Number.	Stamps.	Cost.
oe, Storey, Lyons	95	1,654	$5,802,000
op, Churchill	8	59	370,000
eralda	14	160	590,000
	6	80	370,000
	10	130	920,000
	3	25	226,000
	22	265	1,052,000
	1	10	26,000
	159	2,383	9,356,000

Fluctuations in leading mining shares for the six months ending June 30, 1869.

Name of company.	January 11.	January 20.	January 30.	February 10.	February 20.	February 27.	March 10.	March 20.	March 30.	April 10.	April 20.	April 30.	May 10.	May 20.	May 31.	June 10.	June 21.	June 30.
Gould & Curry	$115	$107	$108	$103	$106½	$105	$112	$108	$112½	$125	$110	$123	$119	$116	$126	$114	$111	$117
Ophir	37	34½	38	38½	41	41	36½	30	31	33½	34	33¼	28	25½	27	25	25½	20
Savage	78	79	78½	63	67¼	67½	70½	67¾	76¾	71½	67	91	99½	114	115	91	86½	90
Chollar Potosi	176	170	171	163	166	166	171	163	180	182	188	245	240	205	422½	324	307½	322
Hale & Norcross	65	59½	70	78	86	80	93	90	92	87	100	152	190	180	178	180	163	150
Daney	3	32½	3	4½	3¾	3½	5	3¼	2½	4	4	4	4¼	2½	3	2	1½	3¼
Bullion	30½	30	28½	20	22	21	20	……	17½	14	10	27	30	22½	23	15	17	22
Overmann	79	81	81	71	68½	69	69	51	58	54	70	91	82	90	90	77	96	100
Sierra Nevada	33	32	29	28	21	28½	35	35	48	50	51	120	……	57	43	44	40	49
Yellow Jacket	1,510	1,497½	1,460	74	69	72¾	70	61½	68¾	57½	58	65½	70	77	75½	65½	56½	57
Amador	250	240	250	255	272½	275	290	278	285	285	288	285	275	270	280	275	280	275
Lady Bryan	16½	16	13¼	11	7	15	17	12½	13	12	9	13	13	17	30	26	25½	50
American	……	……	……	22	13	12	14½	17	21½	27¼	45	56½	61	40	29	24	16	15
Imperial	114	146	144	129	110	111	104	86	89	86	71	77½	78	106	98	81	94	80
Crown Point	54	65	67	68½	68	73¾	75	72½	72	53	52	67	69	69	69	65	57	53
Belcher	160	158	21	30	30	30	23	17½	18½	17	17	22½	18¾	22	21½	24½	26¾	24½
Alpha	58	59	59	52½	53	54	46¾	31	32¼	28	22½	41	37	32½	33¾	27½	26	25
Empire Mill and Mining Company	130	130	128	100	……	75	75	65	60	52	53	46	70	12	66	70	67½	……
Confidence	37	35	……	34	……	31	36	30	32½	34	30	37	30	33	37	54	44	43
Justice and Independent	5	4½	……	14½	……	15	13	……	……	8	……	……	12	6	……	4½	10	……
Exchequer	28	27½	……	27	27	25	20	……	17	……	13	……	……	13	……	14	14	12
Kentuck	140	245	232	228	218	242	268	260	267	250	251	265	250	260	245	212½	188	176
Gold Hill Quartz Mill and Mining Company	……	……	……	……	57½	……	……	……	45	……	……	42½	30	35	38	38	……	42½
Segregated Belcher	8	8½	8¾	9	12¼	11	10½	8½	8½	8	7¼	9¾	82	9¾	10	10	9¼	10

Name of Company.	July 10.	July 20.	July 30.	August 10.	August 20.	August 30.	September 10.	September 20.	September 30.	October 11.	October 20.	October 30.	November 10.	November 20.	November 30.	December 10.	December 20.	December 30.
Gould & Curry	$116	$111	$106	$84	$86	$84	$81	$76½	$69	$67	$68	$77	$85	$84	$77	$72½	$79	$69¼
Ophir	22	21¾	21¼	17	16¾	15	16	14	12½	16½	18¾	16	15½	15	17½	15	14½	15½
Savage	91½	86	80½	54	54½	63½	46	41	35	37½	44½	46	70	71	63	49½	48	45
Chollar-Potosi	305	24¾	23	18½	19¾	18	15	15	14½	14	16½	17	24½	25½	22¾	17½	19	19¾
Hale & Norcross	142½	123	108	118	111	104	127	114	115	121	139	139	180	185	174	143	159	151¼
Daney	3	2½	2	1	1¾	1½	2½	2	......	......	......	75c	1	......	2	......	......	......
Bullion	18	18	16	11	9	10	7½	21	......	......	......	......	......	......	10	10	16½	......
Overmann	87½	75	74	69	81	70	73	71	71½	80	103½	101	93	92½	85	89	80	75
Sierra Nevada	37	8¾	10	8	8½	9½	8½	7	7	7½	15½	13½	15	12½	11½	10⅝	10½	9¾
Yellow Jacket	62½	52½	50	46½	47	39½	47½	40½	35½	35	36½	41½	50	52	47½	41½	45½	51½
Amador	285	290	280	282	267½	280	285	292½	290	282½	280	......	295	290	290	301	315	315
Lady Bryan	40	40	38	......	37½	29	25	......	20	......	9	8	8	10	8¼	7½	7	6¾
American	13½	19	25½	31	27½	29	2½	½	½	......	......	......	......	......	......	......	......	......
Imperial	66	59	60	47	47	40	47	35	29	32	35	35	55	53	47½	39½	52	53
Crownpoint	53½	43	38	27¼	27½	30	28½	22	15	15½	12	11¾	16½	16	13¾	18	19½	18
Belcher	27½	23½	22	19	20½	18½	15	14	13	12¾	11½	13½	14½	16½	16½	16½	16½	15¼
Alpha	27¼	22¼	20	16½	18	17½	14	13½	14	12	13½	14½	20½	24	20½	18½	19	18¾
Empire Mill and Mining Company	60	......	57½	40	35	40	39	......	16	20	16	36	55	61	59	46	......	33
Confidence	50	42½	45	......	30	......	......	......	20	......	20	......	40	20	......	......	......	......
Justice and Independent	8½	8½	7	7	3	......	4	5½	2	1½	1½	3	3	3½	......	......	......	......
Exchequer	12	11½	11	8½	7½	......	8½	5	4	5½	5½	9	12	11½	9	7	8	8½
Kentuck	171	169	207½	182½	180	157½	204	181	170	166½	136	165	185	155	152½	137	148	146
Gold Hill Quartz Mill and Mining Company	57½	60	58	......	......	50	30	32½	......	27	......	30	......	......	25	25	31	......
Segregated Belcher	10¾	10	10	10¼	10½	9	10	7	8	5½	6	6½	6¾	8¾	8½	8½	8¼	7

Quotations of mining stocks January 15, 1870. From the San Francisco Stock Circular.

Name of company.	Number of feet in mine.	Shares per foot.	Total number of shares.	Incorporate value.	Bid per share.	Asked per share.	Last monthly dividend.	Last assessment per share.	When delinquent.
Alpha, (consolidated)	300	20	6,000	$250	$15 00	$15 50		June 3....$5 00	July 2, 1869
Bacon Mill and Mining Company	45		4,000	200			June 19, 1868....$2 00	Nov. 7....10 00	Dec. 11, 1866
Baltimore American	2,000	1	2,000	500				Jan. 12.... 2 00	Feb. 18, 1867
Belcher	1,040	10	10,400	100	15 25	15 50		Oct. 21.... 2 50	Nov. 20, 1869
Bullion, Gold Hill	2,500	1	2,500	400				Nov. 22.... 7 00	Dec. 22, 1869
Central	150	12	1,800	300				June 23.... 2 50	July 22, 1869
Crownpoint	600	20	12,000	250	13 25	13 50	Sept. 12, 1868.... 5 00	Jan. 5.... 7 50	Feb. 4, 1870
Cole, Virginia	3,000		3,000	500					
Confidence	150	12	1,500	500	15 00	20 00		May 4....20 00	June 3, 1869
Consolidated Virginia	1,100	10	11,000	300				Jan. 7.... 2 00	Feb. 6, 1870
Chollar Potosi	2,800	10	28,000	100	19 50		Jan. 10, 1870.... 1 00	Feb. 10....50 00	Mar. 11, 1868
Daney	2,000	4	8,000	60	1 00	1 12		Dec. 7.... 1 00	Jan. 6, 1867
Exchequer	400	20	8,000	300	8 00	8 25		Jan. 30.... 3 00	Feb. 29, 1868
Empire Mill and Mining Company	75	16	1,200	833	20 00		May 15, 1867.... 6 00	Sept. 29....25 00	Oct. 29, 1869
Gould & Curry	1,200	4	4,800	500	57 00	57 50		Jan. 12....15 00	Feb. 11, 1869
Gold Hill Quartz Mill and Mining Company	13⅓		500	500	30 00	34 00	July 13, 1868.... 7 50	May 13....20 00	June 12, 1869
Hale & Norcross	400	20	8,000	200	100 00	100 50	July 10, 1869.... 6 00	Feb. 12.... 5 00	Rescinded.
Imperial	184		4,000	500	42 50	43 00	June 20, 1868.... 6 00	Nov. 15....10 00	Dec. 15, 1869
Julia	2,000	5	10,000	100		1 00		Dec. 23.... 50	Jan. 22, 1870
Justice and Independent			3,000	100	1 00	2 00		July 24.... 5 00	Aug. 23, 1869
Kentuck	95		2,000		133 00		Jan. 10, 1870....10 00	Aug. 5....10 00	Sept. 4, 1869
Lady Bryan	5,000		6,000	300	3 00	4 00		Nov. 24.... 5 00	Aug. 24, 1868
American	2,900	4	11,000	100				Nov. [illegible].... 1 50	Dec. 3, 1869
Occidental Mill and Mining Company			10,0 0	100	15 00	15 25	Mar. 10, 1869.... 2 00		
Ophir	1,400	12	16,800	300	14 00	14 50		Jan. 8.... 2 00	Feb. 7, 1870
Overmann	1,200		3,200	500	66 00			May 15....20 00	June 14, 1869
Segregated Belcher	100	40	6,400	300	7 00	7 75		Oct. 22.... 1 00	Nov. 21, 1869
Savage	800	20	16,000	200	45 75	46 00	June 11, 1869.... 4 00		
Sierra Nevada	3,000	5	15,0 0	200	7 25	7 50	Nov. 16, 1869.... 50	Nov. 16....12 50	Rescinded.
Union	302		1,200	100				June 2.... 5 00	July 2, 1868
United States	1,600		4,000	500				Oct. 15.... 1 00	Nov. 14, 1868
Yellow Jacket	1,200	20	24,000	100	55 00	55 50	Mar. 15, 1869.... 5 00	Nov. 2.... 5 00	Dec. 26, 1869
Amador Mining Company, California	1,850	2	3,700	400	310 00		Jan. 7, 1870....12 00		
Aurora, (consolidated,) White Pine	800	20	16,000	100	9 00	10 00			
Eureka Mining Company, California			4,000	300	240 00	250 00	Jan. 8, 1870.... 7 50		
Golden Chariot, Idaho	750	13	10,000	100	10 00		June 15, 1869.... 3 00		
Silver Cord, Idaho	600	20	12,000	100		50			
Golden Rule, California	3,000	1	3,000	100			Oct. 26, 1869... 50		
Pocotillo, White Pine	800	5	4,000	200				Aug. 2.... 2 00	Sept. 1, 1869
Brodt, White Pine		20	10,000	100		40		June 23.... 25	July 22, 1869
Featherstone, White Pine			14,000	100				Aug. 31.... 60	Sept. 30, 1869
Rising Star, Idaho	1,900	10	12,000	300				Nov. 5,'69 50	Dec. 5, 1869
Original Hidden Treasure, White Pine	600	26⅔	16,000	100	7 50			Aug. 28 .. 2 00	Sept. 27, 1869
Mammoth, White Pine	1,800	20	30,000	100		50		Oct. 28,'69 20	Nov. 27, 1869
Hidden Treasure, (consolidated,) White Pine	600	20	12,000	100				July 3,'69 50	Aug. 2, 1869

CHAPTER XVIII.

EASTERN NEVADA.

year ending July 1, 1869, has been an eventful one for Eastern
la. The completion of the Pacific railroad, so long and anxiously
l for, and the great White Pine excitement, are alone sufficient to
the year noteworthy.

ing excitements, or "rushes" to newly-discovered localities, where
eposits are reported, have been too often and well described to
further elaboration now. It is sufficient to know that the White
ever was one of the most violent of these extraordinary epidemics
xperienced on the Pacific coast. Like many others of its class, it
ie fiercer and blinder the farther one went from its cause. Already
two years before the discovery of the Eberhardt, there was con-
ble excitement about the same district, and a small mill (Monte
o) was erected there, but at that time only the "base range" was
ed, and but little work was done. The rich mines of Treasure
ere discovered by a party of prospectors from Austin, which had
or some years the frontier mining town of the State, and the gen-
utfitting point for new explorations; here came the samples to
ayed and the ore to be crushed from very many new districts, and
pulation had become accustomed to the alternations of hope and
r, of which the life of a frontier prospector is made up. They
en so many hardy adventurers return from toilsome prospect-
peditions ragged, hungry, and physically worn out, but still jubilant
he brilliant future which their loads of specimens foreshadowed,
nfidently anticipating in their new discoveries a speedy cure and
reward for all the suffering they had cost, and in so many cases
bright hopes had resulted in bitter disappointment, sometimes
high only to fall the lower, that the people of Nevada had be-
proverbially slow of belief and weak of faith. By this class, the
res of the Eberhardt, Keystone, and Hidden Treasure were viewed
distrust inspired by the bitter experience of the past; and al-
h large numbers of prospectors hastened to the new "diggings,"
with little hope or expectation that White Pine would prove any-
more or better than Reveille or Hot Creek. It is, however, a
r of routine in a prospector's life to go to every new place that is
ered; and if he gains nothing by it, he consoles himself by the
ion that at least his education has been advanced to the extent
wing that there is nothing there. The unfortunate result of pre-
enterprises in districts where rich ore had been found near the
e in limestone country rock added to this chronic distrust, and
l months elapsed before much confidence was felt in the perma-
of these rich deposits, bearing so striking and ominous a resem-
to other discoveries, which had once promised much and
red" early. It was not until Nevada discovered that San Francisco
lso discovered White Pine, and that California capitalists were
y investing money there, that the excitement grew feverish, and
ctors from every part of the State rushed to the district which
lready acquired the *soubriquet* of the "poor man's paradise."
and older districts were soon almost depopulated; mines and
vere forced to stop for want of laborers; and although the price of
was not materially affected, it was only because both employers
orkmen tacitly understood that wages were already too high to
mining generally profitable.

Reese River district, of which Austin is the center, suffered especially. Very many of the small veins of this district had been worked successfully by common miners, individually or in companies, the great majority of whom hurried to White Pine; and soon only those mines which were worked by foreign corporations continued to produce anything. Many of these miners, commonly known as "chloriders," because they usually extract only the surface or chloride ores, had worked claims upon Lander Hill for years. They had studied the ground and learned the peculiarities of the veins; they understood the ore, and could estimate its value with astonishing accuracy; and although they were rarely particular about the ownership of the mines they worked, and looked upon every idle claim as open to their industry, their aggregate production had been one of the principal items in the bullion returns, and their departure from the district soon made itself unpleasantly felt.

Another result of the White Pine excitement was, that prospecting, which had up to that time tended southward or southeastward from Austin, turned towards the east and north; and ranges which had hitherto been neglected as being in an unfashionable direction, were carefully and thoroughly hunted over, in some cases with very promising results, as Mineral Hill and Cope districts sufficiently testify. Again, several old districts, which had been long ago abandoned or disregarded, on account of limestone country rock, were revisited, and the new light which White Pine had thrown upon this formation led to many discoveries which are said to be of considerable value. Among these may be mentioned Eureka, Reveille, Diamond, Hot Creek, and Cortez. On the other hand, the districts which, a year ago,were looked upon as the most promising in Eastern Nevada, have not yet wholly recovered from the stagnation into which the White Pine fever precipitated them. Many of the miners and prospectors who formerly made these places their headquarters have moved to the new towns in White Pine County, or along the railroad; and the merchants and farmers have gone with them. The reaction has begun, however, and the emigration into the State, induced by the railroad, must assist and strengthen it. It is probable that another year will see the equilibrium fairly established, unless some new disturbing cause arises to prevent it.

The other great event of the year, the completion of the Pacific railroad, has not yet had time to make itself materially felt. It was confidently anticipated that as soon as Nevada should be opened up by the railroad, the opportunities for legitimate mining enterprises would be greatly enlarged and improved. It was hoped that lumber, materials, and provisions would soon be furnished at prices far below those formerly paid for these articles, and that swarms of industrious laborers would rush from all parts of the world to secure the comparatively enormous wages which are here received for all kinds of work. Although some improvement in this respect may already be observed, it must be confessed that the sanguine expectations formerly indulged have been grievously disappointed. The prices of necessary materials and provisions, although somewhat less than last year, are yet far higher than it was reasonably expected that they would be. The blame for this state of things rests principally, although not entirely, with the railroad companies, whose rates of transportation have been placed so high that the benefits usually derived from railroad communication have not been received. A comparative view of the distances traversed by rail and wagon, with the rates of freight, from 1863 to 1869, inclusive, together with the ruling prices of staple articles, may be obtained from the following table. As Austin has been, until the present year, the principal mining center of Eastern Nevada, the table is arranged upon freights and prices as ruling there:

	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.
	Miles.	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*
Distance traversed by rail, (C.P.R.R)	......	....	......	....	....	92	189	396
Distance traversed by wagon	330	330	330	330	330	250	160	95
Total distance Sacramento to Austin	330	330	330	330	330	342	349	491
Highest price paid for freight, per lb	......	$0 25	$0 12	$0 11	$0 07½	$0 06¾	$0 08	$0 06
Lowest price paid for freight, per lb	......	16	16	8½	5	5¾	5¼	3½
PRICES OF STAPLE ARTICLES.								
Flour, per pound	......	20	15	14	10	9	8¼	6¼
Bacon, per pound	......	40 to 50	40	40	35	30	30	27
Candles, per box of 20 pounds	......	12 00	8 00	8 00	7 50	7 00	6 00	5 00
Barley, per pound	......	22	14	12	6½	7½	8	5½
Blasting powder, per keg of 25 pounds	......	25 00	16 00	12 00	7 00	6 50	6 00	5 50
Sugar, per pound, (retail)	......	50	35	35	30	30	30	25
Beans, per pound, (retail)	......	25	20	20	20	16	16	14
Steel, per pound	......	....	60	32	33	32	32	27
Iron, per pound	......	....	20	18	20	18	16	12½
Strap iron, per pound	......	....	30	25	22	18	16	14
Rope, per pound	......	....	45	35	32	32	30	28
California boards, clear, per M	......	....	......	250 00	250 00	200 00	200 00	200 00
California boards, common, per M	......	....	......	200 00	200 00	180 00	180 00	180 00
California shingles, per M	......	....	......	22 50	20 00	18 00	18 00	20 00
California shakes, per M	......	....	......	125 00	80 00	80 00	80 00	60 00
Reese River boards, per M	......	....	......	140 00	140 00	125 00	1[illegible]0 00	100 00

It should be stated that during the years 1865, 1866, and 1867, a large amount of freight was transported by rail to Shingle Springs on the Sacramento Valley railroad, and thence over the Sierras by the Placerville route; but the cost was the same as if shipped direct from Sacramento to Austin; and during the years 1867-'68, when from fifty to two hundred miles of the Central Pacific railroad had been completed, it was found as cheap to load teams at Sacramento for Austin as to send by rail to the terminus and thence by teams to the same place.

When the railroad was first opened from Sacramento to Argenta, freight was put at $50 (gold) per ton, distance 396 miles. From Sacramento to Elko, 468 miles, the rate was $60 75 per ton. On the 1st of July these rates were reduced to $42 to Argenta, and $50 to Elko, and on the 1st of September freight per ton was again reduced to $35 to Argenta and $42 to Elko. This makes the rate about 8.84 cents gold per ton per mile to Argenta, and a trifle over this amount to Elko. From Argenta to Austin the distance is about ninety-five miles, and the ruling rates of freight two cents per pound. This can easily be reduced to one and a half cents. From Elko to Hamilton the distance is about one hundred and twenty-eight miles, and the ruling rates of freight are two and a half to three cents per pound.

The foregoing facts show that while considerable improvement has been made in reduction of freights and staples, a very great deal yet remains to be done. We have seen that high wages will not tempt emigration, unless they are assisted by cheap provisions; and we cannot have cheap mining until the necessary machinery, tools, and materials are afforded at reasonable prices. Freight from Sacramento to Austin ought to come down to one and a half cent per pound; and if the railroad company would be satisfied with what is elsewhere considered a handsome compensation, there would be no difficulty in reducing the rate to this sum. At a little less than three cents gold per ton per mile, freight could be delivered at Argenta at one-half cent per pound, and the cheapening of feed, provisions, &c., which this should occasion would enable teamsters to transport to Austin at one-half the present rates.

The same is true, allowing for the local differences in distance, as to Elko and Carlin; and these three points, which are now the principal inlets of Eastern Nevada, ought to be the centers of a large carrying trade for all the mining districts lying north and south of the line of the railroad. At present trade is done by driblets; enough is shipped to last from day to day. Merchants fear to bring in large stocks on account of the present abnormal expense, and the probable future reduction; and they cannot be blamed for so acting, because where the cost of freight enters so largely into the value of goods, any considerable reduction in freight would bring ruin to them, as it has so often done to others in the history of this State.

The rates of labor in Eastern Nevada have not changed for several years. The following table shows the wages paid for white labor; there have been two experiments made in using Chinese labor, one at Silver Peak, Esmeralda County, and one at Morey district, Nye County, which will be further considered when I come to the consideration of those districts.

	Gold.
Common laborers, per day	$4 00
Extra sorters and miners, per day	4 50 to $5 00
Foremen, per day	5 00 to 6 00
Engineers, per day	5 00 to 7 00
Blacksmiths, per day	6 00
Carpenters, per day	6 00
Masons, per day	8 00 to 10 00
Amalgamators, per day	4 00

It will be observed that there are very few classes of labor mentioned in the above list. In fact, there are very few distinctions made in this respect. Those extra sorters and skilled miners who receive higher wages than ordinary laborers are few in number, and generally very superior workmen. In general, any white man who will work at all demands $4 per day for his labor. It does not matter whether he is a green hand just arrived by the railroad, or has worked in the district since its first discovery, there is one common price; and experience and skill, unless of a very extraordinary, and well-recognized character entitle the possessor to no more than is paid to any ignorant emigrant, whose whole acquaintance with mining is derived from digging the cellar for a house in some eastern town. This startling injustice works evil to both laborer and employer. The latter pays one workman for what he does not get, and gets from another workman what he does not pay for. The intelligent and industrious miner does his own work and also that of his stupid and indolent comrade. The best men are kept down for the benefit of the poorest. And yet the working classes who are really most injured are most strenuous for the continuance of this absurd system. A good example of the way in which this works is seen in the sorting of ore. An old hand, practiced and skillful, sorts carefully, cleanly, and quickly. A new and inexperienced man sorts slowly and throws away much good rock, which the other one would save; and at the end of the day, working with such ore as is common in eastern Nevada, he has absolutely thrown upon the waste-pile two or three times his wages. Practically, the poor sorter has received $12 for his day's work, of which he has immediately thrown away $8, which is a total loss to all parties. If the ore happened to be of a very high grade, the loss would be much larger; and there are probably many mining men in the country who can give examples where, by this mode of reckoning, $40 to $50 per day have been virtually paid to green hands.

The miners' leagues insist, and generally succeed, in the suicidal demand that these men, whose labor has such different values, must all receive the same wages. An employer's only recourse is to discharge all whom he finds incapable and employ new men whom he has not yet found incapable. Even this is not always possible, nor can he always know who are the best men to retain. The workmen foolishly combine to conceal the necessary data. It would be a great improvement if labor were classified into different grades, with pay proportionate to the character and amount of the work. By this system good miners would get the higher wages, which they honestly deserve, and employers would get something like the worth of their money.

In many districts, Indian labor has been profitably made use of, but rarely to any very considerable extent. The Shoshones and Pah Utes, who are the original inhabitants of this part of the State, differ from the Indians ranging east of the Rocky Mountains, in being intellectually lower, physically uglier, and morally better. They are almost invariably ultra-peaceful, and are generally quite willing to work. It is a curious fact, and not common among other tribes, that the males do as much work as the females. As aids to prospecting, these Indians have proved exceedingly valuable. The best districts and richest mines in Eastern Nevada, since the first discovery of the Reese River district, have been shown to the white prospectors by Indian guides. They generally bring first to the prospector specimens of the "napyas," or quartz; and if this looks well, they are promised a horse or some small sum of money for showing the locality. As laborers, they are used for packing ore up or down hill, for wheeling away dirt, for cutting bunch-grass or hay, and for all the rougher work required about new mines. They are generally paid from fifty cents to one dollar per day, with food.

The general results of the year 1868-'69 may be summed up as follows:

1. A slight reduction in the prices of freights and merchandise.

2. No reduction in the rates of white labor; but two experiments, claimed to be successful, in using Chinese labor.

3. Prospecting in the neighborhood of the railroad greatly stimulated, and also in limestone districts.

4. Discovery and opening up of several new and promising districts, some of which are already yielding handsomely. On the other hand, several old and hitherto highly esteemed districts have been neglected, and in some cases almost deserted.

At present the country seems to be in a state of transition. Developments have proved, beyond doubt, the existence of very rich mines and deposits in Eastern Nevada, and have shown at the same time that many of them cannot now be worked with profit. To make them profitable, the present enormous expense of mining and milling must be reduced. Most of the foreign companies owning and working mines in this part of the State are of Eastern origin and incorporation. The agents and superintendents sent out by these companies were often good enough as men, but poor enough as miners, and sometimes poor enough from both standpoints. It has been fashionable to attribute the failures of most mining enterprises to the blunders and incapacity of these mismanagers. This would be a very easy solution, but I think it a very unjust one. In the first place, if the mines had been as rich as they were claimed to be, selected idiots could not so soon have brought these enterprises into the financial embarrassment in which most of them speedily found themselves. Secondly, experience has shown that mines of established merit, managed with the greatest shrewdness, skill, and economy, can make but little headway against existing prices and processes. Mismanagement is bad enough; but if there had bee nothing else in the way of success, there would have been fewer failure A brief examination of the local circumstances attending the minin and milling of ores in Eastern Nevada will, I think, point out the difficulty and indicate the remedy.

The ores of Eastern Nevada may, for practical purposes, be divide into two classes:

1. Chloride ores, in which the silver occurs almost entirely in the form of the chloride of silver, (sometimes associated with the bromide o iodide, or both.) White Pine district affords the best examples of the occurrence of this kind of ore. It occurs also in most of the other silver districts, but rarely in such quantity and purity. This ore can be worked without roasting, and can be profitably milled for $20 to $25 per ton.

2. Sulphuret ores. Antimonial ores would be a better name for this class, but the foregoing is the designation generally used. The great bulk of the Eastern Nevada ores are comprised in this class. In these ores the silver occurs united with more or less antimony (for which, in rare cases, arsenic is substituted) and sulphur. The minerals belong to the great family of sulphantimoniurets, with the products of their decomposition. Among the more prominent may be mentioned ruby silver, stephanite, polybasite, tetrahedrite, stelefeldtite, and many others. This class of ore must be roasted in order to extract the silver. It cannot now be milled profitably for less than $40 to $45 per ton.

It is impossible to give any reliable figures as to the expense of mining these ores. There are few mines which have been regularly and systematically worked for any considerable length of time, and the local circumstances are widely various. One mine has perhaps a broad vein or deposit, easily worked from the surface, and another a narrow but rich vein, which can only be reached through regular hoisting works; or one has easy picking and the other hard blasting rock. Moreover the stage of development has much to do with the expense of taking out the ore. Hence no average estimates worthy of confidence can well be made. In some rare instances the cost of extraction has not been more than $5 per ton, while in others it has exceeded $100. Chloride ore being usually near the surface and the result of decomposition, can generally be extracted for considerably less than sulphuret ore, which occurs lower down and often only below the water-line. It is probably safe to say that chloride ore which pays less than $35 per ton, and sulphuret ore which pays less than $60 per ton, are worked only at a loss to the miner. This assumes for chloride ore, $10 for mining and $25 for milling; and for sulphuret ore, $15 for mining and $45 for milling per ton.

The foregoing facts are alone amply sufficient to explain to any mining engineer the failure of so many mining enterprises in Eastern Nevada. Ore which elsewhere is ranked as first-class is here only worthless dirt. Experience throughout the world has shown that mines generally yield a large proportion of low-grade to a small proportion of high-grade ore, and this country is no exception to the rule. A few cases have occurred when mines have for some time yielded large amounts of very high-grade ore, but there is no case known where this has continued permanently, and no sane engineer would base his calculations on such an expectation. The rule is: "*Rely* on your low-grade ore, and *hope* for high-grade." Here the rule is reversed, and we are compelled to rely upon our hope. In well-managed mines elsewhere, almost all the valuable mineral which comes out of the mine is saved and beneficiated. Here we throw one liberal portion on the dump-pile and lose another in the mill. A mine oduces ten tons of ore per day; eight tons are low-grade and go to e dump-pile; two tons are high-grade and go to the mill. Out of the say value of these two tons eighty per cent. is paid to the miner, from hich he deducts $90 to be paid for mill charges. The remainder must y him for mining and extracting ten tons, and, if possible, a profit on s outlay besides. The wonder is not that many mining enterprises ve failed, but that any have succeeded. It should be remembered at no effort is made to dress the ores. They are roughly sorted in unks as they come out of the mine, and so go to the mill.

The difficulty, then, seems to be that only high-grade ore can be pro- ably worked with present prices and processes; and it is not often at such ore can be obtained in large amounts. It is surprising how ich of this high-grade ore is extracted. The county of Lander paid tes on $2,278,749 43 bullion produced during the year ending July 1, 69. The figures for the county of Nye for this year are not now before , but I find by the State controller's published report that for the st three quarters of 1868 this county paid taxes on $722,628 42 of bul- n. This bullion does not come from one locality, as in the case of Comstock, but from a great number of mines scattered about here d there in different districts; and almost all of it is the product of at would anywhere else be considered as extraordinarily high-grade —not made high-grade by judicious and skillful dressing, but raw, concentrated, almost as it came out of the earth. If this is the pro- ct of the high-grade ore only, what would be the product if all the ore re worked?

One fact at least is conclusively established by the foregoing figures. ese mines have yielded and are still yielding large quantities of silver. e problem now remaining is to reduce the expense of extraction so to make them yield a profit commensurate with the capital and labor ich they require. This problem is in the hands of an enterprising, entive and thrifty people, and its solution cannot be very distant. will require but little examination to see where these expenses can reduced.

A. *Labor.*—The ruling rates for common labor are far too high. The ustice of classing skilled and ignorant labor together has already been uded to. An experienced practical miner, who understands the pecu- rities of the mines and the breaks and dislocations of the veins, whose dy, intelligent help and quick suggestion might be of great benefit any of the emergencies to which all mines are subject, earns and de- ves high pay; but such men, and there are many of them, should be emen or superintendents, instead of common miners. There is no od reason why ordinary, unskilled labor should be cheap elsewhere d dear here. The country is easy of access; the cost of living, though atively greater than in other States, is nevertheless entirely dispro- rtionate to the high price paid for work; and the climate, though cer- inly not always agreeable, is almost universally healthy. Nor has it oved that the laboring class has generally benefited by the existing ite of things. Many shining examples there certainly are, where in- stry and economy have taken advantage of high wages; but in the jority of instances, the working man earns the money only to enrich e gambler or the dram-seller. One good reason might perhaps be signed for the continuance of these high rates, and that is, that it is great help to many prospectors, (who are doing the hardest and best rk in the State,) as it enables them to earn in a few months enough to pply them with provisions and materials for the remainder of the year. But there is no use in finding new mines if we cannot make them available when they are found.

Chinese labor is cheap and docile; but there are serious disadvantages connected with it, which need not be developed here. White labor can be imported into the country, enough to supply its wants and at rates which will be fair to both employer and employé; and this will probably be the actual course pursued, unless the resistance and unreasoning obstinacy of the working miners shall force employers to a still more radical change.

B. *Fuel.*—This is one of the principal items of expense in both mining and milling. The wood used comes from the mountain ranges, some of which are well covered with timber, some sparsely, and others not at all. The principal varieties are white pine, nut pine, cedar, and mountain mahogany. Nut pine and cedar are most common, and the former makes excellent fuel. The price of wood in districts which have been much developed and where the demand is considerable, is rarely less than $10 per cord. The supply is at best but limited; and the trees grow so slowly that there is almost no prospect of a new growth to take the place of those cut down. Wood enough can be procured for a few years, even allowing for a much larger consumption than the present; but after that the fuel must be supplied from some other source. Probably north and south railroads will eventually furnish the country with this necessity by bringing in coal from the immense coal-fields east of Salt Lake. In the meantime, a great improvement could be made in the consumption of wood for mining purposes by consolidating the working of mines and using few shafts where many are now kept open, or by running deep tunnels and thus escaping the heavy expense of hoisting and pumping machinery altogether. A great deal of money is annually thrown away to no purpose by the useless multiplication of shafts, when one large, well-constructed shaft, with suitable machinery, would do the work much better and at much less cost. If the mines are owned by different companies and they cannot otherwise agree, it would be much wiser to sink a union shaft and pay the expense according to the work done and advantages derived. This has been successfully carried out elsewhere; and there is no good reason why it cannot be done here. Many of the mining districts of this part of Nevada are admirably situated for tunneling purposes. One deep tunnel which penetrates and drains the veins of a whole hill is obviously better and cheaper than the present system of working each vein by its own shaft or incline.

C. *Processes.*—Some improvements which could be easily made in mining have been alluded to under the foregoing head. There are several other points in which material progress can be made. Among these may be mentioned—

1. Single hand drills. Mining men who have introduced the use of single hand drills, especially in connection with giant powder, seem to be almost unanimously of the opinion that they are much more economical than the old system. In many cases one man can do the work of two; the extent and quality of each man's work stands for itself, and his pay can be regulated by it; a good driller is no longer dependent on the striker, and the work is much more easily supervised. A still greater improvement in this direction, which is destined to create a radical reform wherever it can be conveniently applied, is the use of—

2. Machine drills. Very few attempts have been made to introduce these great labor-savers in Eastern Nevada. This is the more to be re-

gretted as the country seems admirably adapted for their use. If they can do one tithe of what is claimed for them, they may be safely counted among the agents of the coming reduction in mining expenses.

3. Giant powder. Of all the new explosives which have recently been offered to the public, this seems to be the only one which can claim a success in the mining regions of this coast. But this success is not without qualification. For working in wet ground, as in the bottom of shafts or the face of drifts, its superiority is unquestioned; but great loubt is expressed by good practical authority whether it can claim any precedence over black powder in dry ground or where the rock is not very hard. One great obstacle in the way of the introduction of this powder is the high price at which it is sold. The current price in this part of Nevada has been $1 30 to $1 60 per pound, or from six to seven imes the price of black powder. It can certainly be afforded at a much ower rate, and doubtless soon will be.

As far as milling processes are concerned, the opportunities for improvement and reduction of expenses seem to be mainly confined to one branch. The ore is almost invariably crushed dry, as it must generally be roasted after it leaves the battery. After centuries of experiment, no crushing apparatus has yet been discovered which does its work better than the old-fashioned stamp battery, with its few modern improvements. The alligator-jaw crushers, from which so much was hoped, while they failed in superseding the battery, proved extremely useful as an adjunct to it; and few well-constructed mills are now without such a crusher to prepare the heavy ore for the stamps. Experience has shown that heavy stamps of seven hundred to eight hundred and fifty pounds each, run at a rapid rate, say eighty-five to one hundred drops per minute, do more and better work than any others; and while, a few years ago, a ten-stamp dry-crushing mill was believed to be doing good work if it crushed seven to eight tons in twenty-four hours, now such a mill easily crushes the same amount in twelve hours.

The great item of expense in treating Eastern Nevada ores lies in the oasting. The special object of the process of roasting is to convert the ilver, otherwise combined in the ore, into the chloride of silver. The chloride ores, it will be remembered, already have their silver in this form, and consequently they require no roasting. Mills which work these ores only, and are sure of a constant and abundant supply, can easily afford to reduce for a less sum than that formerly given. Indeed the price of such milling in Virginia ought soon to rule in Eastern Nevada also, as the process is nearly the same, and the cost here should be about what it is there. But, with the exception of a few mills in White Pine district, most of the Eastern Nevada mills are calculated for the reduction of sulphuret ores, and are therefore dry-crushers, and provided with roasting furnaces. The cost of roasting ranges from $15 to $20 per ton, and the process in the present reverberatories is tedious, clumsy, and troublesome. It is in this direction that a great advance is necessary and possible; and the continuance of the present awkward and expensive method is a scandal upon American ingenuity. Several improvements have already been suggested, of which the chloridizing furnace of Mr. C. A. Stetefeldt is the most prominent and promising. An experimental furnace of Mr. Stetefeldt's design was erected in 1867, at the mill of the Twin River Company, Ophir Cañon, Nye County, and the result was entirely satisfactory to all parties; but the unfortunate failure of the company in New York, before working furnaces were put up, delayed further progress until this year, when a working furnace was built at Reno, Neada, for an English company. This has already (November, 1869) been thoroughly tested; and its success will probably effect a change in the whole system of working sulphuret ores.

Amalgamation is carried on in, 1. Freiberg barrels; 2. California pans. Notwithstanding the length of time during which this process has been used, no definite conclusion has been reached as to which of these methods is preferable. Mill men seem to be content to let temporary convenience guide their choice, and are generally in favor of the method to which they are most accustomed. It is highly desirable that this question should be determined, and either barrels or pans definitely settled upon as the better apparatus.

The mills usually return eighty per cent. of the assay value to the miner, although in special cases, and for high-grade ore, eighty-five or even ninety per cent. is returned. Probably there are few cases where the mill does not save more than eighty per cent., and this surplus generally goes to the profit of the mill.

Very little has been done toward beneficiating the tailings, notwithstanding their known richness. The principal obstacle seems to be that there is not yet a sufficient quantity in any one place to warrant the erection of suitable works.

D. *Taxation on the proceeds of mines.*—By the amended revenue act of 1867, a State tax of 1.25 per cent. is levied on the proceeds of mines. To this the county tax is added, which swells the total to 2.90 or 3 per cent. The law provides that the value of the ore shall be estimated on the dump before milling, and that the sum of $18 per ton shall be allowed free from tax for the expense of extraction and reduction of ore which does not require roasting, and $40 per ton for ore worked by the Freiberg or roasting process. The ores of the Comstock lode, in Storey County, which come under the former provision, are generally low-grade, and are mined and milled on so large a scale that $18 probably pays the total expense of extracting and reducing a large proportion of them. The ores of Eastern Nevada, on the other hand, are of high grade, and, as has already been shown, the expense of mining and milling them is very heavy, far exceeding the amount allowed by law for that purpose. In very many cases, after mining and milling expenses are paid, there is a considerable loss to the miner, upon which he is, nevertheless, compelled to pay a tax. This tax is made a lien upon the mine; and no matter whether the ore is taken out and worked for the benefit of the owner of the mine, or by parties leasing from him, or even by parties working without his consent, the mine is held for the tax levied. If A owns a mine, and B extracts ore from it without A's permission, and, owing to the heavy expense of mining, loses money by his surreptitious speculation, A's mine must actually pay the tax on B's loss, unless, indeed, B himself pays it, which he frequently omits to do. The unjust operation of this law is clearly shown by the State controller's report for the year 1868. The following table is collated from pages 49 and 50. The returns for the last quarter of 1868 were not then in.

uarterly assessment rolls of the proceeds of mines for the quarters ending March 31, *June* 30, *and September* 30, 1868.

County.	Quarter.	Quantity.		Average value.	Total value.	Amount on which tax is paid.	Amount of tax.
		Tons.	*lbs.*				
rey	First	44, 017	380	$30 41. 7	$1, 338, 873 23	$546, 108 81	$8, 191 61
rey (ores sold)	First	8, 317	1, 400	....	9, 738 16	9, 738 16	146 05
rey	Second	94, 488	1, 230	29 69. 5	2, 805, 882 73	1, 141, 978 17	17, 129 64
rey (ores sold)	Second	18, 781	230	....	21, 497 20	21, 497 20	322 46
ey	Third	92, 476	910	29 92	2, 767, 082 03	1, 119, 374 56	16, 790 15
ey (ores sold)	Third	19, 488	1, 470	1 34	26, 187 72	26, 187 72	392 81
Total	....	277, 569	1, 620	....	6, 969, 261 07	2, 864, 884 62	42, 972 72
der	First	2, 003	687	174 81. 3	350, 211 13	270, 077 39	7, 832 62
der	Second	2, 158	1, 908	210 88. 5	455, 290 32	368, 932 16	10, 698 97
der	Third	1, 941	1, 138	371 12. 9	720, 574 25	637, 862 33	18, 497 99
Total	....	6, 103	1, 733	....	1, 526, 075 70	1, 276, 871 88	37, 027 58
	First	1, 903	403	122 43. 5	233, 019 34	165, 098 07	4, 787 74
	Second	2, 460	85	112 26. 1	276, 167 17	192, 902 58	6, 076 43
	Third	2, 613	128	81 66. 3	213, 441 91	139, 827 18	4, 404 61
Total	....	6, 976	586	....	722, 628 42	497, 827 83	15, 268 78
der and Nye	....	13, 080	319	....	2, 248, 704 12	1, 774, 699 71	52, 296 36

From this table it appears that upon a total value of $6,969,261 07
e county of Storey paid a tax of $42,972 72, while upon less than one-
rth of that value, the county of Lander paid a tax of $37,027 58, and
e two counties of Eastern Nevada, Lander and Nye, (White Pine and
ko Counties were then comprised in Lander,) paid nearly $10,000 more
than Storey upon a production of a little less than one-third. An
lustry like mining, which is just struggling into existence, is greatly
ured and depressed by taxation which discriminates against instead
in favor of it; and there is every probability that the next legisla-
re will amend the revenue law so that it shall no longer be counted
ong the obstacles in the way of successful and profitable mining.

I have thus considered four of the principal items of expense in min-
g and milling, and pointed out how they may be reduced and a great
vance effected. To these should be added one other item, which was
plained in considering the effect of the completion of the Pacific rail-
lroad, viz: the high rates of freight, merchandise, mining materials,
. It is curious to observe how all these high prices hang together
d are supported by each other, and how all efforts at reform and im-
ovement in one direction are defeated by blind conservatism in others.
e railroad companies and freighters complain that as the business is
t large, high freights are necessary; the merchants complain that
ce freights are high, high prices for goods are necessary; the labor-
s complain that since goods and the necessaries of life are high, they
ust have high wages for labor; the dealers in wood complain that since
or and horse-feed are high, they must demand a high price for fuel;
e miner complains that since fuel and labor are high, he can only ex-
ct high-grade ore; the mill man complains that since fuel and labor
high, and only high-grade ore in limited quantities can be worked,
must have a high price for milling; and mechanics, artisans, lawyers,
sicians, in short, everybody who has anything to sell, declares that
e everything else is high, he, too, must have a high price for his
icles or services, in order to keep up with the rest.

The early pioneers of Eastern Nevada undertook great risks and endured great hardships; they plunged fearlessly into an unexplored desert; the country yielded nothing edible except pine nuts, and it was very difficult and extremely expensive to bring in supplies from California; they carried on their explorations among mountains and valleys where one may often travel for days without finding water, and, with the agonies of thirst before them, were frequently compelled to abandon their animals and baggage, and make the best of their way to the nearest spring. Unacquainted with the climate, and unprepared for its peculiarities, the first winter prostrated hundreds of them with a dangerous and painful sickness, and great numbers of these unfortunate adventurers died in their miserable tents and hovels, less from disease than from the want of proper shelter and suitable care. In these days and under these circumstances, high wages were paid and deserved; and high prices were natural and proper. But that time has passed, and with it the risks, hardships, and discomforts which belonged to it; and the continuance of the old abnormal prices, under new and improved circumstances, is not only unjust, but suicidal.

How long shall this condition of things last? How long shall folly and obstinacy delay the development of a country which ought to rank among the greatest bullion-producing districts in the world? Everybody sees that reform must come, but very few seem to be willing to do anything towards hastening it.

CHAPTER XIX.

LANDER COUNTY.

During the year 1869, two new counties were organized out of portions of Lander County. White Pine County may be said to comprise the southeastern quarter of the old county, and was organized April 1. Elko County comprises the northeastern quarter, with an additional strip, about thirteen miles wide, on the west, and was organized on the 5th of July.

REESE RIVER DISTRICT.

This district contains over six thousand mining claims, and is the pioneer district of Eastern Nevada. The city of Austin, the county seat of Lander County, is the principal "camp" in the district. It lies in a cañon between two hills, (Lander and Union,) upon which the best known mines of the district are located. The present population of the district is estimated at between three and four thousand.

The price of labor has already been given; the cost of fuel ranges from $9 to $11 per cord; the cost of quicksilver 68 cents per pound, and of salt about $40 per ton. Lumber (California clear) costs $200 per thousand, and native or Reese River lumber, $100. Mining timbers (six feet long by six inches square) cost about $75 per hundred. A ten-stamp mill of the California pattern could be erected at an expense of $40,000 to $50,000. A twenty-stamp mill would cost from $70,000 to $90,000.

Mines.—The general characteristics of the mines of this district have been sufficiently described in preceding reports; and it is now only necessary to briefly recapitulate the main points. They are true fissure arrow but rich, numerous and close together, and frequently ch pockets of chloride ore near the surface. There are two of veins, one striking northwest and southeast, and the other ıd south, of which the former are believed to be the older, and o be the more valuable. The country rock is granite, except in hern portion of the district, (formerly known as Amador district, r consolidated with Reese River district,) where slate occurs. loride and sulphuret or antimonial ores are found, the former nd the latter below the water line.

› great number of locations which appear on the mining records, ıtively few have been opened to any extent. In the fever of the citement, every little streak of quartz or of anything which a ıgination could believe to resemble quartz, was located and re- until there was absolutely a dearth of names to apply to min- ms. Most of these locations were afterward abandoned, and : more promising received much attention. The following list es most of the prominent mines in the district, upon which much ıs been done, and gives also some idea of the manner in which ve been opened. In early days, claims were almost invariably by means of inclined shafts, but of late vertical shafts have nerally preferred.

List of the prominent mines in Reese River district.

Name of mine.	Locality.	Owned by—	How opened.	Power used.	Depth in feet.	Title.	Remarks.
Apollo	Lander Hill	Railroad Consolidated Co	Incline	Windlass	30	U. S. patent	Work suspended.
Black	Lander Hill	Railroad Consolidated Co	Incline	Windlass	110	U. S. patent	Work suspended.
Blue	Lander Hill	Railroad Consolidated Co	Tunnel and incline	Windlass	50	U. S. patent	Work suspended.
Bonner	Lander Hill	H. Bonner	Incline	6 horse-power engine	250	Miners	
Buel North Star	Lander Hill	Lane & Fuller Company	Incline	Lane & Fuller shaft	600	U. S. patent	In full work. Ore reduced at Mettacom mill.
Buckeye	Lander Hill		Shaft	10 horse-power engine	210	Miners	Active.
Camargo	Union Hill	Railroad Consolidated Co	Incline	Windlass	285	U. S. patent	Idle.
Chase	Yankee Blade	Chase Company	Tunnel and shaft	20 horse-power engine	[S] 275	Miners	Work temporarily suspended; patent applied for.
Confidence	Yankee Blade	Confidence Company	Incline	Works removed	180	Miners	Idle.
Confidence No. 2	Yankee Blade	Owners unknown	Incline			U. S. patent	Idle.
Congress Independent	Union Hill	Railroad Consolidated Co.	Incline	Windlass	100	U. S. patent	Work suspended.
Diana	Lander Hill	Diana Company	Shaft and incline	20 horse-power engine	180	U. S. patent	Work suspended.
Eclipse	Union Hill	Railroad Consolidated Co.	Incline	Windlass	110	U. S. patent	Work suspended. Known as Whitlatch Union.
Fortuna	Lander Hill	Fortuna	Incline	8 horse-power engine	400	Miners	Work suspended.
Foster	Central Hill	J. P. Kelly	Incline	Hoisting w'ks remov'd	250	U. S. patent	Work suspended.
Florida	Lander Hill	New York and Austin Co.	Incline	40 horse-power engine	600	Miners	Leased to Sampson & Co. Patent applied for.
General Hooker	Lander Hill	United Reese River Co	Incline	Windlass	135	Miners	Idle.
Gov. Seymour, 1st W. ext	Lander Hill	T. D. Johns	Incline	Windlass	200	Miners	Idle.
Great Eastern	Lander Hill	Shoshone Company	Shaft	Works removed	315	U. S. patent	Idle.
Harding & Dickman	Lander Hill	Harding & Dickman	Shaft and incline	Windlass	90	Miners	Idle.
Hubbard	Central Hill	Hubbard Company	Shaft and incline	Windlass	480	Miners	Idle.
Jo Lane	Lander Hill	Railroad Consolidated Co.	Incline	Windlass	20	U. S. patent	Leased.
Lane & Fuller	Lander Hill	Lane & Fuller Company	Shaft	60 horse-power, 2 eng's.	545	U. S. patent	Working Buel North Star and other ledges.
Maggie	Yankee Blade		Tunnel and incline	Works removed	160	Miners	Leased.
Magnolia	Lander Hill	Magnolia	Incline	10 horse-power engine	400	Miners	Idle. Patent applied for.
Mettacom	Yankee Blade	Mettacom Company	Incline and shaft	Mettacom mill	214	Miners	Work suspended. Patent applied for.
Morgan & Muncey	Lander Hill	Morgan & Muncey	Incline	20 horse-power engine	300	Miners	Active.
Morgan & Muncey No. 2	Lander Hill	E. F. Morse & Co	Incline	10 horse-power engine	200	Miners	Leased.
Morse	Lander Hill	Boston and Reading Co	Incline	Works removed	220	Miners	Idle.
Naiad Queen	Central Hill	New York and Boston Co.	Incline	Works removed	200	Miners	Idle.
North River	Central Hill		Incline	10 horse-power engine	280	Miners	Leased.
North Star	Lander Hill	Manhattan Company	Shaft	20 horse-power engine	320	U. S. patent	In full work. Ore reduced at Manhattan mill.
North Silver King	Amador	Silver Queen Company	Incline	Works removed	200	U. S. patent	Idle.
Oregon	Lander Hill	Manhattan Company	Shaft	25 horse-power engine	553	Miners	Leased. Patent applied for.
Old Colony	Lander Hill	South American Company	Incline	10 horse-power engine	300	U. S. patent	Idle.
Peerless	Amador	William C. Lipp	Incline	Windlass	40	U. S. patent	Idle.
Plymouth	Lander Hill	Plymouth Company	Shaft	30 horse-power engine	430	Miners	Active.
Providential	Lander Hill	Providential Company	Incline	Works removed	450	Miners	Idle.

[illegible]	Lander Hill	Savannah Company	Incline	Works removed	300	Miners	Work suspended. Patent applied for.
Sherman	Lander Hill	New York and Austin Co	Shaft	120 horse-power engine	270	Miners	Work suspended. Shaft sunk for Florida ledge.
Sam Brannan	Lander Hill	Sam Brannan Company	Incline	Windlass	90	Miners	Work suspended. Patent applied for.
Silver Chamber	Union Hill	Silver Chamber Company	Incline	Whym	380	U. S. patent	Work suspended.
South American	Lander Hill	South American Company	Shaft	30 horse-power engine	316	U. S. patent	Work suspended.
Southern Light	Lander Hill	Manhattan Company	Shaft and incline	Works removed	270	Miners	Work suspended. Patent applied for.
Stranger	Lander Hill	Stranger Company	Incline	Works removed	280	Miners	Work suspended.
Timako	Lander Hill	Manhattan Company	Incline	10 horse-power engine	500	U. S. patent	Leased.
Toiyabe	Lander Hill	Toiyabe Company	Shaft	35 horse-power engine	300	Miners	Active.
Trojan	Lander Hill	Trojan Silver Mining Co.	Shaft	20 horse-power engine	200	Miners	Active. Shaft sunk to strike Revenue.
Troy	Lander Hill	New York Silver Min'g Co	Incline	15 horse-power engine	500	Miners	Leased. Patent applied for.
Tuolumne	Yankee Blade	D. Cooper, and others	Tunnel and incline.	Windlass	80	Miners	Leased.
Tuscarora	Marshall's Cañon	Tuscarora Company	Incline	6 horse-power engine	150	Miners	Work suspended.
Vedder			Shaft	Works removed	320	Miners	Idle.
Wall & Isabella	Lander Hill	Railroad Consolidated Co.	Incline	15 horse-power engine	300	Miners	Active. Patent applied for.
Washington	Lander Hill		Incline	20 horse-power engine	200	Miners	Idle.
Washington No. 2	Lander Hill	John A. Paxton	Incline		200	U. S. patent	Idle.
Whitlatch Yankee Blade	Yankee Blade	John A. Paxton	Incline	40 horse-power engine	200	U. S. patent	Work suspended.
Yankee Blade	Yankee Blade	American Company	Shaft	60 horse-power engine	302	Miners	Active.
Smith & Martin	Lander Hill	Bacon	Incline	Windlass	90	Miners	Idle.
Revenue	Lander Hill		Incline	Windlass	155	Miners	Active.

This table shows that many of the prominent mines of the distri are now lying idle. Some of these have not been worked for one two years, and the inclines and drifts are now inaccessible. In suc cases information as to the depth to which they have been worked mu be gathered from other sources; and possibly some of the measur ments given in the table are inaccurate in this respect. In severa cases, the hoisting works have been removed. This frequently indicate the failure, not so much of the mine, as of the miner. Often develop ment proves that, under existing circumstances, the ore produced is to low in grade to make its extraction profitable; the machinery, which i in demand and available for other localities, is sold, and the mine shut down to wait for better times. There are many claims in the district from which very rich ore has been extracted, and which, under favorable conditions, might develop into excellent mines; but they have been omitted in the list, and only those given upon which much work has been done, or which have become prominent for other reasons. It will be observed that quite a respectable number of government patents have been obtained for mines in this district. A still larger number has been applied for. The insecurity of the old miners' titles has become so obvious that there is a general desire to procure settled and definite rights which are not dependent on doing one day's work every month, or a jury's idea of what constitutes such a day's work.

One of the greatest obstacles in the way of successful mining in Reese River district, is the great number of small veins claimed by different individuals. Each mine is generally worked for itself, and sometimes there is hardly room on the surface for the necessary buildings and dumps. On Lander Hill, there is one place where, within a space of about one acre, there are five different hoisting works belonging to different owners. This is obviously a very expensive and inconvenient way of working mines. Again, it is not always practicable to keep reserves ahead with one small vein, especially in cases where mine and mill are owned by the same party. Ore must be obtained for the mill; and if in prospecting ahead a barren spot is reached, the known reserves must be attacked to supply the deficiency. In working large veins or many small veins this difficulty is not felt. If one vein is temporarily barren, there are others to fall back upon. Much better work at much less expense could be done on Lander Hill, if one company owned a large number of parallel or contiguous claims and worked them through one or two shafts, or through a deep tunnel. (See report of last year, page 79.)

The high prices of fuel, labor, mining materials, &c., and their discouraging influence upon mining enterprises have been already considered. There are also certain difficulties of a local nature with which Reese River district has to contend. Prominent among these are—

1. Irregularities in the width and richness of the veins. Sometimes the vein "pinches" and becomes a mere seam in the granite, or the quartz and valuable minerals entirely disappear and in their place appears a vein of clay; or the vein widens but contains hardly a trace of silver. The deep workings of the past year have given much valuable information as to the character of the Lander Hill veins, and have shown that generally they are wider and more uniform in depth than at or near the surface. It is now certain that many of the small claims, which were located and worked as distinct veins, are only spurs or offshoots from the main fissures, and unite with them at short distances from the surface.

2. Breaks and dislocations of veins. These have proved a constant

of vexation and confusion ever since the first attempt at work-
veins of Lander Hill. For a long time their cause and nature
ntirely misunderstood, and large amounts of money were ex-
in seeking for lost veins in the direction which they were most
y to have taken. It is now well settled that great slides have
country rock and ore down the hill, and that to recover a lost
is necessary to follow up the clay seam which marks the slide,
t is generally a shorter and more convenient method, cut straight
h the solid country-rock until the vein is met coming down again.
mber of these slides cannot yet be determined, but it is certain
ere must have been at least two great movements which have
the principal "faults" thus far encountered. There are also very
mall faults or "jumps," where the vein has slipped a few feet;
se are of minor importance and occasion but little inconveni-
Again, these slides appear to have been irregular in extent and
. In some cases the slide seems to have had a pivotal end; one
of the vein has slid further than the other; and thus, what is a
reak in one mine is a large one in another, on the continuation
ame vein. In other cases the slide has been deeper in one por-
the vein than in others; and thus one mine meets the break
e surface, while another, on the continuation of the same vein,
t reach it until a considerable depth has been attained. The
nportance of thoroughly understanding these slides and faults is
ious to need comment. They have been developed at so many
t points, where surveys and measurements could be taken, and
en observed and studied for so long a time, that it would seem
obtain a good practical knowledge of them and of the general
which they are governed. Unfortunately, the two companies
works are the deepest and most extensive on Lander Hill, and
ssess the most information upon this subject, are unwilling to
ublic their costly experience.

se metals. The veins on the western portion of Lander Hill
to carry much base metal; and the bullion produced from them
s so much copper and so little silver that sometimes it will
pay to ship. The base minerals are copper pyrites, galena, zinc-
and others. The copper pyrites occurs often as a brilliant
ine drusy coating on the sides of seams or thin fissures, and
rangely enough, long believed by the miners to be the iodide of
The unfortunate result of the deeper workings on this portion
ill, and the general belief that this result was caused by the
ce of a "base belt," has induced an almost total abandonment of
es in this vicinity. Although this imaginary base zone may be
d where so many believe it to be, the evidence of its existence
its, thus far produced, is certainly very unsatisfactory. On and
e surface very rich chloride ore was found; the veins were gen-
arger and more regular than those lying east of the so-called
belt;" and the whole theory seems to rest upon the experience of
ines, which, at a depth of two to four hundred feet on the vein,
d ore which yielded base bullion. What is wanted is a deep
which shall tap the veins at a considerable vertical depth, and
hly test and prospect them. The Trojan shaft, under the excel-
perintendence of Mr. John Howell, is now going down on this
and we may hope for important developments from it during
ing year.

f the most noticeable features of mining in Reese River district
n the partnerships of labor which have been formed among

miners to work the veins of foreign companies, who have found it impossible to do this themselves without loss. These partnerships are o very common occurrence, and are generally made between miners o skill and experience, who frequently employ many others to assist them in doing the work. Of course, such men get only the best of labor Good miners themselves, they are stimulated by the hope of a rich reward, and, being thoroughly acquainted with the miners around them, they employ only the best, and get the worth of their money. They are incorporations of industry; one partner runs the engine and does the blacksmithing above ground; another is busy running a drift or breasting a rich stope below ground, and, at the same time, supervising the work of the men employed as helpers, while two more, perhaps, relieve these at the end of the shift. These little companies manage their affairs with a shrewdness, enterprise, energy, and economy which the larger companies would do well to imitate; and besides paying a fair compensation out of the product of the ore to the legal owners of the mine, they often divide among themselves a very handsome surplus. Several cases are known where, during the past season, individual miners, with no capital but their skill and experience, and no investment but their labor, have netted from $3,000 to $5,000 in gold.

The minerals found in Reese River district have been arranged, according to Dana's system, in the following table, by E. N. Riotte, mining engineer, of Austin. A table from the same source was published in Mr. Browne's report of 1867, page 430, but it was marred by typographical errors, and also defective in many respects, owing to the fact that some of the minerals were, at that time, necessarily accepted on hearsay. It is now given, revised, with the addition of all later discoveries.

I. Native elements: Native gold, native silver.
II. A. Binary compounds: 1. Stibnite. 2. Silver glance, erubescite, galena, blende, copper glance, stromeyerite, pyrrhotine. 3. Pyrites, marcasite, leucopyrite, chalcopyrite, mispickel, molybdenite.
B. Ternary compounds: Pyrargyrite, proustite, tetrahedrite, polybasite, stephanite.
III. A. Binary compounds of chlorine, &c.: Common salt, kerargyrite, bromyrite, iodyrite (?), embolite.
IV. Compounds of fluorine: Not represented.
V. A. Oxygen binary compounds: Red copper, hematite, braunite, hausmannite, rutite, pyrolusite, göthite, manganite, psilomelan, wad, molybdite, quartz, opal.
B. Oxygen ternary compounds, (salts:) Pyroxene, rhodonite, hornblende, chrysolite, epidote, muscovite, lepidolite, oligoclase, orthoclase, sphene, tourmaline, chrysocolla, scheeletine (stolzite,) hübnerite, (wolframite ?) anglesite, gypsum, barite, jarosite, cyanosite, copperas, stetefeldtite, pitticite, niter, glauber salts, calcite, magnesite, dolomite, chalybite, aragonite, cerussite, trona, natron, malachite, azurite.
VI. Hydro-carbon compounds: Not represented.

The production of the mines of Reese River district may be obtained from the following table, which has been kindly furnished by Mr. Thomas W. Triplett, county assessor of Lander County. The table gives the production of all the districts in Lander County for the year ending July 1, 1869. As has been already stated, White Pine County was cut off from Lander County on the 1st of April, 1869; and consequently the production of White Pine is included in that of Lander, except for the last quarter.

Exhibit of producing mines in Lander County, Nevada, on July 1, 1869.

Name.	District.	Amount of ore.		Product for the year ending July 1, 1869.
		Tons.	Lbs.	
o. 1	White Pine	402	213	$60, 837 69
o. 2	Reese River	2	1, 194	715 79
	White Pine	10	1, 040	563 08
	Reese River	26	106	4, 768 44
h Star	Reese River	1, 033	1, 152	279, 205 38
ce	White Pine	1	622	138 36
sta	White Pine	1	404	110 41
et	Reese River	2	314	260 50
	Reese River	1	1, 228	517 14
ce	Reese River	1	1, 628	275 82
a	Newark	178	1, 725	16, 199 14
	Reese River	15	40	3, 320 03
	White Pine	5	1, 121	1, 557 37
ak	Reese River	1	211	114 84
gle	White Pine	3	1, 731	957 66
	Reese River	20	859	3, 813 17
	Reese River	12	1, 114	2, 311 36
l	Reese River	2	1, 612	583 64
	White Pine	9	648	820 13
	White Pine	7	1, 902	4, 767 03
	White Pine	1, 530	....	781, 716 03
	White Pine	3	1, 434	1, 030 45
	White Pine	14	1, 568	5, 402 41
	Reese River	23	30	6, 495 40
	White Pine	9	163	1, 061 24
one	White Pine	21	1, 543	1, 714 02
	Reese River	142	408	38, 146 93
	Reese River	6	600	1, 761 71
	White Pine	102	1, 047	16, 374 35
ntain	White Pine	3	450	3, 027 68
	White Pine	....	857	147 89
	White Pine	6	1, 658	1, 167 16
easure	White Pine	308	1, 597	52, 296 06
Logan	White Pine	3	1, 630	1, 419 08
	White Pine	1	277	236 64
Chief	White Pine	2	....	420 70
nd Dickman	Reese River	56	1, 262	26, 822 04
Bound	Reese River	14	596	5, 940 16
	White Pine	5	1, 155	1, 298 93
	White Pine	24	1, 235	3, 832 31
	White Pine	1	1, 683	416 28
	White Pine	....	1, 660	129 98
	White Pine	275	265	165, 158 03
	Reese River	8	386	1, 841 52
cker	White Pine	1	366	229 68
ce	White Pine	31	647	8, 169 68
n	Reese River	2	152	690 20
	Cortez	3	1, 854	309 73
	White Pine	36	161	3, 350 92
i	White Pine	2	1, 548	1, 836 98
	Reese River	79	700	24, 894 54
Muncey	Reese River	3	1, 934	904 57
	White Pine	11	1, 312	435 68
a	Reese River	1	336	214 28
	Reese River	18	648	2, 465 41
ry	White Pine	7	1, 585	2, 521 05
rnon	White Pine	1	53	515 70
	Reese River	1, 648	1, 454	247, 384 50
	White Pine	12	999	1, 523 04
	Reese River	11	1, 884	1, 436 51
	Cortez	10	746	2, 211 37
	Reese River	21	1, 022	4, 799 51
dan	White Pine	....	1, 406	138 98
	White Pine	3	434	406 40
	White Pine	....	1, 004	128 84
e	White Pine	6	1, 995	884 45
	White Pine	19	840	5, 723 96
onte	White Pine	....	1, 515	154 22
	White Pine	....	1, 946	143 45
met	White Pine	158	902	82, 741 16
d	White Pine	5	1, 972	1, 373 54
	White Pine	3	976	763 84
rican	Reese River	143	1, 495	42, 551 41
	Reese River	47	964	12, 115 71
Douglas	Reese River	....	610	33 20
nber	Reese River	22	38	7, 165 80
	Cortez	53	1, 684	37, 202 35
	Reese River	1	1, 824	505 66
	Reese River	1	1, 142	90 70

Exhibit of producing mines in Lander County, Nevada, &c.—Continued.

Name.	District.	Amount of ore.		Pr the y Ju
		Tons.	Lbs.	
S. C. Baker	Reese River	1	738	
Santa Rita	White Pine	32	245	
Seymour	White Pine	8	1, 547	
Stambole	White Pine	2	1, 354	
Stonewall	White Pine	68	257	
Snow Drop	White Pine	8	767	
Timoke	Reese River	13	204	
Toiyabe	Reese River		1, 244	
Troy	Reese River	26	1, 103	
Tuolumne	Reese River	14	690	
Vedder	Reese River	1	346	
Virginia	White Pine	8	803	
Vancouver	Reese River		748	
Wabash	Reese River	2	192	
Washington	Reese River	6	496	
Williams	Reese River	13	1, 203	
Watson	Reese River		820	
Whitlatch Yankee Blade	Reese River	3	1, 680	
Yankee Blade	Reese River	54	360	
Unknown mines		716	1, 801	

From this table it appears that 7,667.559 tons of ore, averagin nearly $297 20 per ton, and yielding a total of $2,278,749 43, w tracted and reduced in Lander County during the year. amount, 3,190.25 tons, averaging $395 95 per ton, and yielding a $1,263,208 79, are credited to White Pine district; 178.862 ton aging $90 56 per ton, and yielding a total of $16,199 14, came fr Chihuahua mine at Newark, in White Pine County; and 68 ton the high average of $584 18 per ton, and yielding a total of $39, came from Cortez district, in Lander County. The remaining 4, tons, averaging $226 84 per ton, and yielding $959,617 05, are c to Reese River district. In this last amount, the proceeds o whose names are unknown to the assessor are included, and as s this ore probably came from outside districts, the true produ Reese River district alone may probably be safely put at $900,00 mines, lying side by side, the North Star, Manhattan Company, an North Star, Lane and Fuller Company, are credited with $526,58 this sum. These two are the only mines in the district which said to have been regularly and systematically worked for the pa Many other mines have been worked spasmodically, and some o sufficiently to show that they might be made to yield richly and antly; but their owners postpone making any persistent effort developing them until the coming of better days and lower price

Accounts.	July.	August.	Sept'ber.	October.	Nov'ber.	Dec'ber.	January.	Febr'ary.	March.	April.	May.	June.	Total.
RECEIPTS.													
Mine	$25,108 79	$58,482 38	$8,002 77	$6,023 72	$23,101 56	$7,583 37	$30,569 39	$4,289 11		$48,880 35	$9,549 39	$3,955 21	$225,555 04
Buel North Star Company				1,202 25									1,202 25
M. Dyer, jr				1,000 00					$4,000 00			10,000 00	15,000 00
Supplies					462 06						31,75		493 81
Incidental expenses										500 00			500 00
Total	25,108 79	58,482 38	8,002 77	8,225 97	23,563 62	7,583 37	30,569 39	4,289 11	4,000 00	49,380 35	9,581 14	13,955 21	242,751 10
Amount overpaid July 1, 1869													8,803 46
Grand total													251,554 56
EXPENDITURES.													
Hardware	$37 00		$331 59			$804 75				$25 00	$2,053 83		$3,253 07
Incidental expenses	341 80	$152 60	1,627 75	$79 50	$90 00	1,065 80	$650 00	$1,572 00	$693 50	1,025 23	687 50	$121 50	8,107 18
Lumber		2,781 72	969 60	614 75	1,356 10	894 56	1,500 00	1,365 86	25 00	66 00	630 20		10,203 79
Labor	3,651 18	11,507 00	2,329 80	9,856 37	11,236 25	12,760 25	8,305 50	7,111 65		14,483 50	7,478 00	8,891 75	97,611 25
Machinery	493 50	240 98					537 00		22 80	90 00	1,633 35		3,017 63
Supplies	170 50	635 95	5,389 64		1,370 80	401 97		375 97	7 50	847 75	617 45	112 50	9,930 03
Blacksmithing											40 11		40 11
Charcoal	164 85	11 00	52 50	108 30	146 65			169 57		110 00	85 40	85 75	934 02
Telegraphing	8 50	116 45	6 50	60 40	39 75	98 75		26 25	28 00			110 16	494 76
Hauling	43 50	163 00	58 50	60 00	78 00	508 85	145 00			387 50		34 00	1,478 45
Construction					30 00		250 00		335 00	1,608 00	194 00		2,417 00
Interest and exchange		235 94	48 52			367 55		511 38	475 74	118 67	256 42	232 64	2,246 86
Expense	250 00		1,000 00	500 00	500 00	500 00	500 00	500 00	500 00	500 00	500 00	500 00	5,750 00
Wood	1,193 62	338 00	982 64	499 50	1,090 25	1,370 15			1,673 75	911 00		400 00	8,458 91
Contract			325 00	1,242 50	957 25			531 50		837 25	1,246 78		5,140 31
Mine			300 00							100 00			400 00
Milling	4,741 56	8,310 03	2,452 27	1,786 32	5,738 49	1,894 14	7,458 43	612 00		9,485 28	2,425 50	1,274 22	46,178 24
Litigation	81 60	1,000 00	250 00					49 00		55 25	500 00	174 00	2,109 85
Tax					275 40	2,357 18		672 44				591 62	3,896 64
Assay						63 00			33 00	151 50		6 00	253 50
Freight							396 43	330 30	149 75	7 50	27 50		911 48
M. Dyer, jr	17 38	17,535 48		2,700 00		1,500 00	1,000 00			1,500 00			24,252 80
Buel North Star Company		1,769 79	744 64	3,000 00			2,000 00						7,514 43
Stock account		2,000 00											2,000 00
Total	11,194 99	46,797 94	16,868 95	20,507 64	22,908 94	24,587 05	22,742 36	13,827 92	3,944 04	32,310 36	18,376 04	12,534 14	246,600 37
Brought forward from July 1, '68													4,954 19
Grand total													251,554 56

NOTE.—During the fiscal year ending July 1, 1869, the mine has produced 1,029.558-2000 tons of ore, from which mill returns gave $224,050 38, averaging $217 68 per ton. The main shaft has been sunk to the depth of 445 feet, and levels run of 3,282 linear feet. Additional engine of 30 horse-power placed at mine for pump, and Cornish pump of 4-foot stroke, 6-inch bore, placed in mine. Also fire-engine placed at the work, and steam-saw.

Return of production of bullion for the year ending July 1, 1869, *in the Manhattan mill, Austin, Nevada, reported by A. A. Curtis, superintendent.*

Month.	Ore from North Star mine.				Custom ore.				Grand total.	Stamps run.	
	Tons.	Pounds.	Av'ge yield per ton.	Total yield.	Tons.	Pounds.	Av'ge yield per ton.	Total yield.		Days.	No.
1868.											
July	62	....	$145 03	$8,991 59	268	1,270	$238 31	$64,020 71	$73,012 30	21	20
August	50	1,435	101 84	5,164 97	479	600	339 72	162,827 40	157,992 37	31	20
September	147	1,000	127 37	18,787 30	428	1,680	314 04	134,673 96	163,461 26	30	20
October	270	1,000	135 17	36,565 27	274	903	210 34	57,729 30	94,294 59	31	20
November	67	1,000	128 68	8,686 36	413	1,000	289 27	119,614 90	128,301 26	22	20
December	104	1,824	143 50	15,055 74	81	1,176	194 64	15,880 63	30,936 37	14	20
1869.											
January	192	1,790	103 54	19,961 67	391	210	218 31	85,384 63	105,346 30	31	20
February } March }	Mill not	running.									
April	59	1,490	192 31	11,489 62	447	526	273 12	122,155 84	133,645 46	30	20
May	307	18	116 03	35,623 22	137	466	241 90	33,196 93	68,820 15	14	20
June	243	1,500	144 77	35,290 29	117	....	252 16	29,502 54	64,792 83	19	20
Totals and averages	1,507	57	129 80	195,616 03	3,038	1,831	271 79	824,986 84	1,020,602 87	243	20

Remarks.—From January to June, 1868, the mill reduced 1,955 tons of North Star ore, yielding $290,227 79. The custom ore crushed in August and September, 1868, was from White Pine. Power of engine, 120 horse-power. Actually used, about 80 horse-power, Stamps, 750 pounds, 85 drops per minute; double cams. Bullion about .850 fine. The 10 roasting furnaces will roast about 19 tons per day, at an estimated cost of $15 per ton.

This table shows that the batteries reduced, in 243 days' running, ,546 tons of quartz, or an average of 18.7 tons daily, which is about .645 ton per day per horse-power developed by the fall of stamps, $\left(\frac{18.7}{20} \div \frac{750 \times 9 \times 85}{12 \times 33{,}000} = 0.645.\right)$ This is a high average for dry crushing, though not quite so high as that of the Mettacom mill running at greater speed. The number of men employed in the mill is 58, distributed as follows: batteries, 3; drying kilns, 5; pulp, 3; coolers, 2; pans, 4; retort, 1; engineers, 2; woodmen, 3; repairs, 2; foremen, 2; roasters, 30; assayer, 1.

Estimates of work for the rest of 1869.

Oregon shaft, 180 tons per month, 6 months	1,080 tons.
East North Star, 60 tons per month, 6 months	360 tons.
custom ore, 160 tons per month, 6 months	960 tons.
Total	2,400 tons.

The aggregate production of the mill for 1869 will therefore be not far from $670,000, reckoning the North Star and Oregon ore at $130, and the Custom ore at $200 per ton.

During the year ending July 1, 1869, the Manhattan Company has extracted, principally from the North Star ledge, 1,988 tons of ore, at a cost of	$102,074 45
Which includes everything but the dead-work of extending drifts; this amounted to	48,945 17
Making an aggregate mining expense of	161,019 62

The amount of stoping ground opened is 1,894 linear feet, with 200 feet backs, or more than 10,000 square fathoms. I think the present reserves of the mine contain at least 5,000 tons of good ore. The North Star shaft is 320 feet deep. The average number of men employed in the mine during the year referred to was 64. The aggregate of days' work was 20,613, making 320 days the average working year. The company is using black powder, with single-hand drills. The latter will be employed altogether, as soon as tools can be secured. There has been no difficulty in introducing them thus far. Giant powder is employed in sinking shafts, and when the ground is very hard. The principal objection to its use is the high cost.

Estimate of costs of mining and reducing ores in Reese River district.

Population of district: Between three and four thousand.*
Wages of first-class miners: Four dollars per day.
Wages of second-class miners: Four dollars per day.
Wages of surface laborers: Four dollars per day.
Cost of lumber: One hundred and twenty dollars per thousand.
Cost of mining timber: Seventy-five cents for six inches by six feet.
Cost of common powder: Twenty-two to twenty-six dollars per one hundred pounds.
Cost of giant powder: One dollar and forty cents to one dollar and fifty cents per pound.
Cost of quicksilver: Sixty-eight cents per pound.
Cost of freight from Argenta: Two cents per pound.
Cost of fuel: Nine to eleven dollars per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Forty thousand dollars to fifty thousand dollars.*

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* Estimated.

Cost of twenty-stamp mill, freight, erection, &c.: Seventy-five thousand dollars to one hundred thousand dollars.*

The mining cost per ton of ore varies at the same mine excessively, according to the width of the vein and hardness of the ground. In the Manhattan I believe it has been as high as fifty dollars per ton; and, indeed, the average cost per ton for the year ending July 1, 1869, at that mine, (all expenses except dead-work included,) was over fifty-one dollars. Other mines on Lander Hill are not likely to have been much better off.

Minimum reduction cost: Thirty-six dollars and twenty-eight cents per ton.

For a description and discussion of the Mettacom mill, as a model mill, using the Reese River process, see the second part of this report.

Mineral Hill district is situate about thirty miles south of Carlin, a station on the Central Pacific railroad, but, as yet, unconnected with that place by a road. The country rock is limestone, and principal locations are made on a small knoll detached from the main chain of mountains. The ores are said to be rich silver ores. About fifty claims have been located, and they are reported to cover about all the mineral which is worth claiming.

Spring Valley district, organized in June, 1869, is situated a little south of east from Austin, and distant from that town about sixty-five miles. It is only sixteen miles southwest from the Eureka district, and limestone is the principal formation. The ore brought to Austin, so far, assays well, but no working tests have been made yet. It consists of a rich variety of stetefeldtite.

CHAPTER XX.

NYE COUNTY.

REVEILLE DISTRICT.

The geological description of this district is given in detail in the commissioner's report of 1869, pages 107 and 108. On this occasion it is therefore only necessary to describe some of the more important claims which have been opened and worked so far.

It will be remembered that the district, covering an area of about three by six miles, lies about one hundred and thirty miles southeast of Austin and one hundred and ten miles south of Treasure Hill, on the west side of Railroad Valley. Indian Jim discovered the district in 1866; it was organized October 2 of that year. It is a dry, burnt, desolate-looking place. A little water can be had by digging in the porphyry. For milling purposes, however, no sufficient amount of water is found nearer than twelve miles. Material for brick, which would stand the heat of a roasting furnace very well, is abundant.

The silver ores of the district occur in the prevailing formation, dolomitic limestone, in pockets and apparently isolated deposits. Large dikes and croppings of quartz protrude frequently above the surface of the ground. In their neighborhood are found the best pay streaks and pockets, which, although irregular and following no certain course, are sufficient in magnitude to fairly justify the expenditure of money to follow their variations and to expose new masses. The smaller deposits generally furnish the richest ore, silver glance and silver-copper glance, with more or less chlorides. Galena predominates in two or three mines, but is generally quite rare. There are very few silver ores containing arsenic or antimony in the district as far as known at present. The ly exception in this respect are one or two mines on the Middle Moun- in. The larger quartz ledges carry poorer ores, but being of greater xtent, they promise the surest investment.

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* Estimated.

The mines are situated on North, Middle, and South Mountains. The rgest bodies of quartz, carrying low-grade ores, are found on the east- rn slope of South and on Middle Mountains.

The following are the most important mines of the district:

The Fisherman, on the northwest side of South Mountain, half-way own the foot-hills, shows very extensive surface indications, perhaps e most important on that slope. The work done consists of the sink- g of a shaft 30 feet deep, which, commencing in a pocket of rich re, out of which $15,000 are said to have been taken, stops in solid olomite. There are other rich croppings along the supposed line of e ledge, but the hard country rock disheartened the owners and work as suspended. A ton and a half of ore from this mine, worked at age's mill, Austin, yielded $1,632 per 2,000 pounds; five tons crushed t the Oregon mill averaged $730, and 70 tons in all $400 per ton.

A little south and on the same slope are the Pearl, Greengage, Orleans, oanoke, Laurel, and Berkshire. They have recently been purchased y Hooper, Hunt & Co., together with Brobant Creek for milling pur- oses.

The Amazon, in the foot-hills, is owned by Mr. Brooks and reputed o be a good mine.

The Nonpareil, on the southeast slope, belongs to Hooper & Co. The eposit shows a preponderance of galena and some silver.

On the north of the mountain are located:

The Elvetica, owned by Hawes & Co., carrying silver and silver-cop- er glance. It is opened by a shaft ten feet deep and shows con- iderable ore.

The Sparta, a recent location. There are very extensive croppings n this property; one solid body rises ten or twelve feet above the round and has a width of about fifteen feet, showing silver-copper lance throughout.

The Castle Rock, apparently on the same line of croppings, is situate n the other side of a ravine intervening between the two claims. Two ssays of ore from this mine gave $263 and $103 per ton of $2,000 ounds. None but assessment work has ever been done on this claim.

The Young America, a new location near by, is parallel to the Elvetica nd Sparta. There is quite a body of quartz exposed in this mine. It hows some silver glance and horn-silver; sample assayed $215 to the n.

The Knickerbocker, running east and west on the summit of the ridge, an old location owned by Hawes & Co. In a shaft 50 feet deep the eposit of ore is exposed, getting narrower toward the bottom. There re about twenty tons of ore on the dump. Considerable has been milled ithout roasting. First-class ore yielded $205, second-class $80 to the n.

The Blue Jay is a neighboring location, on which only assessment ork has been done. It shows some silver glance and chloride, a selected mple of which assayed $422 per ton.

The Pocahontas, running north and south, has somewhat the appear- nce of a contact fissure vein. At least a ditch, 18 inches wide and feet long, exposes a remarkably regular west wall of clay and por- hyry. Its dip is perpendicular; its width ten feet. The ore is not very ch, but uniformly distributed, and the entire mass is probably pay ck. Selected samples assayed from $232 to $490 per ton.

The Grant, parallel to the foregoing, is about one hundred yards distant, and shows the same arrangement of the mineral as the foregoing location. A selected sample assayed $464 per ton.

The Emmet, Washington, Mars, Jefferson, and Noon lie close together a little north of the Pocahontas. They are not opened, but the quality of ore found in the croppings encourages further development.

The Hiawatha and Marysville lie still further north, show good croppings, and no base metals. A sample of the former assayed $64, of the latter $779 to the ton of two thousand pounds.

The Saddle, near the Blue Jay, and further around on the northeast slope, the Buckeye, Desert Queen, Indian Queen, Last Chance, Union, Revenge, Mammoth, Silver Peak, Vicksburg, Arrah-na-Pogue, Brick Pomeroy, Shamrock, I. O. U., Examiner, Express, Pumpkin Pie, Bentonville, show all more or less rich croppings. None of them, however, are sufficiently opened to justify an opinion as to their value.

The Park mine, on Middle Mountain, has been explored similarly to the Fisherman, and was abandoned with very little ore in sight. Three lots shipped to Belmont yielded $780, $800, and $1,480 per ton, respectively.

On the North Mountain the Yager, the Rainbow, the Superior, and many others show promising croppings, but, as on all the other locations of the district, the work done up to the present is insufficient for a decisive test of value.

No doubt many of these mines would abundantly pay for the outlay of capital. It is no easy task to select out of some four hundred locations the best ones, and capitalists should therefore intrust this task to the most experienced professional men only. The working of such mines, too, requires the greatest professional skill and circumspection. The system of robbing the rich outcrops, and then abandoning the mines as soon as the harder limestone has to be dealt with, must be discontinued. Thorough explorations in vertical and horizontal directions are necessary before extensive mills are built; miners must always keep in mind that a system of vein mining is out of place where there are no veins, and that the mining laws of a district should be adapted to the peculiar mode of occurrence of its mineral deposits.

Without the aid of outside capital, the mines of this district will probably never be developed. At the same time they offer sufficient inducement for judicious investment and exploration, especially since White Pine has proved that limestone has hitherto received too little credit from our western miners as a mineral-bearing formation.

MOREY DISTRICT.

I am indebted to Mr. D. S. Ogden for the following information:

This district lies about seventy-five miles southeast of Austin, and fifteen miles north of Hot Creek, in the Diamond range of mountains. Entering the main cañon from the east, it rises from three to six degrees for a distance of about three miles. Upon the left the mountain, rising above the foot-hills about two thousand feet, presents a very rugged and bold front. Its northeastern slope, extending for about five thousand feet at an angle of twenty to thirty-five degrees, carries the outcrops of ten or twelve silver-bearing veins. Their width varies from four to five feet, and the pay streaks in them are from six inches to two feet thick. The surface ore presents a dark, dull appearance; lower down a bright-yellow mineral is found, probably antimonate of lead, which yields by assay $377 per ton. Small lots, worked by mill process, yielded $133 to $241 per ton. Two of these veins have been worked to a limited extent by the former owners. The pay streaks near the surface about one foot wide had widened, at a depth of from seventy-five to one hundred eet, to three feet. The vein matter is soft and easily mined. A great leal of the work can be done with the pick, so that the cost of mining is educed much below the general average in Nevada. The veins being f sufficient width, very little country rock has to be removed in sinking r driving. The whole country to the east, north, and south of the mines s thickly covered with the kinds of wood peculiar to Eastern Nevada—ut pine and cedar. Water for milling purposes is abundant on either ide of the mountain on which the mines are located. Bunch grass is ufficiently plenty for stock-feeding. On the whole, this district presents uch better facilities for successful mining than a majority of the mining ocations of the State.

The company working these mines is at present sinking two inclines nd driving one tunnel. Part of this work, viz: the sinking of one incline nd the driving of the drift, is performed by Chinese laborers. They ave been in the company's employ for three months. When first ngaged, they were awkward in the use of the pick and drill, and could ot perform nearly as much work per day as white miners. Now, their ork is entirely satisfactory. Two of them sink five feet in six days in shaft five by nine feet, in rock which has all to be blasted. Two others re driving a tunnel, and advance one and a half foot per day of ten orking hours. White miners employed on the same work before could ot do any more. The Chinese show good judgment in selecting the laces for the holes to be drilled, and are very exact and reliable in ssorting ores. So far, they seem to be equal to white miners in all the ork intrusted to them.

ELY DISTRICT.

Ely district is near Meadow Valley, about one hundred and forty miles outheast of Hamilton, and forty-five miles south of Patterson. Quite number of claims have been taken up in this district, and many of hem are highly promising. The more prominent ones are the Alvira, ix feet wide, assays of specimens $150 to $500; the Sunbeam, four feet ide, assays $100 to $450; the Harris and Pioche, from ten to twenty eet wide; the Fallis, a well-defined ledge, assays of which have yielded s high as $400; the Vermillion, assays from $90 to $4,000; the Tresoro, Caroline, Louisa, and Montezuma, all assaying well. The latter ledge ontains some native silver, and crops out for a distance of over five hundred feet. The formation is limestone and slate. The climate is comparatively mild, and grass is plenty, so that animals can do well all winter.

SILVER PARK DISTRICT.

Silver Park district is a new district situate one hundred miles nearly ast from Hamilton, and twenty-five miles southeast of Patterson. The ines are in a low range of hills, between the Shell Creek or Patterson nd Shoshone ranges, on two hills higher than the rest. The country ock is limestone and porphyry; the gangue of the veins mostly quartz. On the first hill reached from the Patterson side, a very large outrop of quartz, running at right angles to the range of the hills, which northwest and southwest, is filled with rich silver ore; on the secnd, called Mineral Hill by the discoverers, the silver ore is generally ffused through the limestone in threads and pockets. About one hunred claims have been located, the most prominent of which are the lver Star, Hasseyampa, Miner's Dream, Mineral Hill, Savage, Eureka, an Stoomel, and Nevada Queen. On the last-mentioned claim a cut twenty-five feet has revealed a body of ore eight feet in width, all of ich appears to be good milling ore. The country in the neighborhood these mines is well provided with grass, wood, and water.

Statement of ore worked in Nye County, Nevada, during 1867 and 1868.

District.	Mine.	Production in 1867—Coin.				Production in 1868—Coin.				Total for two years.			
		Tons.	Pounds.	Value in gold.	Average per ton.	Tons.	Pounds.	Value in gold.	Average per ton.	Tons.	Pounds.	Value in coin.	Average per ton.
Philadelphia	Highbridge, dry crushing and roasting.					1, 272	1, 835	$130, 002 47	$102 13	1, 272	1, 835	$130, 002 47	
	Highbridge, wet process					2, 048	60	40, 463 12	19 75	2, 048	60	40, 463 12	
	Transylvania, dry crushing					182	1, 812	24, 337 16	133 06	182	1, 812	24, 337 16	
	Transylvania, wet	2, 802	1, 081	$125, 303 54	$44 71	334		9, 301 27	27 85	3, 136	1, 081	134, 604 81	$42 91
	El Dorado, dry	14	1, 262	2, 926 20	200 00	434	232	63, 464 97	146 19	448	1, 494	66, 391 17	147 95
	El Dorado, wet					7	1, 000	476 74	63 56	7	1, 000	476 74	
	Other mines	9	1, 198	2, 402 10	250 24	56	1, 639	7, 526 08	132 45	66	837	9, 928 18	149 48
Twin River	Murphy	3, 847	1, 000	427, 648 74	111 15	1, 942	1, 000	211, 850 09	109 06	5, 790		639, 498 83	110 45
	Other mines	12	1, 154	2, 615 72	207 98					12	1, 154	2, 615 72	
San Antonio	Liberty	283		34, 486 46	121 86	423	1, 204	37, 648 84	88 88	706	1, 204	72, 135 70	102 09
	Other mines					1	949	398 70	270 04	1	949	398 70	
Union	Storm King	55	1, 911	4, 897 98	87 53	131	1, 431	13, 428 15	101 95	187	1, 342	18, 326 13	97 65
	Indianapolis	88	1, 130	8, 132 40	91 83	237	52	18, 274 23	77 09	325	1, 182	26, 406 63	81 10
	Clipper	33	1, 815	2, 847 85	83 99	13	1, 463	1, 357 55	98 86	47	1, 278	4, 205 40	88 28
	Other mines	120	806	11, 284 54	93 72	141	295	12, 118 35	85 85	261	1, 101	23, 402 89	89 48
Hot Creek	Old Dominion	111	252	11, 961 51	107 64	19	905	1, 104 51	56 77	130	1, 157	13, 066 02	100 06
	Other mines	45	165	2, 561 62	56 82	73	1, 691	7, 738 38	104 79	118	1, 856	10, 300 00	86 60
Reveille	Sundry mines	92	282	17, 432 63	189 19	23	1, 268	4, 295 26	181 79	115	1, 550	21, 727 89	187 67
Morey	Sundry mines	97	1, 689	11, 744 55	120 03	61	1, 653	8, 689 11	130 83	159	1, 342	19, 833 66	124 21
Manhattan	Sundry mines					1	500	87 65	70 12	1	500	87 65	70 12
Mammoth	Sundry mines	23	1, 713	892 79	37 42	11	368	2, 296 79	205 36	35	81	3, 189 58	91 02
Other districts	Sundry mines	4	133	589 02	144 84	7	692	1, 020 04	138 91	11	825	1, 609 06	140 99
Totals		7, 642	1, 591	667, 727 65	87 38	7, 426	49	595, 279 46	80 01¼	15, 068	1, 640	1, 263, 007 11	83 81

CHAPTER XXI.

WHITE PINE COUNTY.

This county has been created out of Lander County since last year's port, and many of the mines hereinafter noted were described in that port under the head of Lander County. The boundaries of the new unty are laid down as follows: The initial point of starting is on the stern portion of Shannon's Station, which is located at the western se of the Diamond range of mountains, and, by the road, forty miles st of Treasure City. The exact meridian of this city is not yet estab-hed, but it is not far from thirty-seven degrees thirty minutes west m Washington, and the western boundary of the county is at about irty-eight degrees. From Shannon's station the western line runs uth to the northern line of Nye County, which is a few miles north of e thirty-ninth degree of latitude. This line is the southern boundary the county to the eastern boundary of the State. The northern undary line passes east and west through the northern portion of mp Ruby, and includes the overland road. The county has an area about eight thousand square miles. The districts at present organ-d in it are the Diamond, Newark, Egan or Gold Cañon, Hercules, binson, and White Pine. Some people think that Patterson, Cave, d Grant are in White Pine County, but surveys will certainly prove em in Nye. Mines have been found in the mountain ranges east of e Egan range, but I am not aware at the present time of any districts ving been formed there. The great wealth of the districts mentioned well known. Egan was the first organized in the eastern part of the ate, and it has produced a large amount of bullion. The organization Diamond district followed, but, although a great number of mines ve been located and good results obtained, it cannot boast of having pped many thousand dollars worth of bullion. Many tons of ore have n taken to Austin for reduction, and the value of the mines has been ved by mill tests. But all the work has been done by miners unaided capital, and a great deal could not be accomplished in this way. mond district is on the western slope of Diamond Mountain, a little thwest of Hamilton, contains wood and water in abundance, and ny advantages favorable for making it a first-class district. Hercules l Robinson districts are some fifty miles directly east of White Pine, ve been known for several years, and, although undeveloped, are in h favor with many. They are located in the Egan range. White ne district is situate near the southeastern corner of the county, and ludes some of the loftiest peaks of the State. Its unexampled wealth now known all over the world. Treasure City, built at an elevation 9,000 feet above the sea, is the chief town, and probably the highest y in the United States. The present population is estimated at four ousand, and the surrounding towns of Hamilton, Shermantown, and her villages in the district add twice as many more. Twenty-five iles west of White Pine is Newark district, flanking the eastern slope Diamond Mountain. Its mines, as far as developed, prove to be h. The leading metal extracted in the county is silver, but as eco-mical mining advances much wealth will be reaped from its mines lead, gold, copper, antimony, and salt, with which the rocky hills d barren plains are stored. But mining will not represent the only sources of White Pine County. Vast areas of agricultural and graz-g lands, capable of supplying its own inhabitants with provisions, are contained in its boundaries. It is already noted for the quality of its beef and mutton and the richness of the butter and milk produced in it. The surface is made up of alternating ranges of mountains and valleys, isolated peaks with narrow chasms, broad passes, and elevated valleys. On the west is the lofty and continuous Diamond range, extending north and south across the county. At its eastern base is the broad Newark Valley, separating it from the White Pine range. In this valley are vast areas of salt, alkali, and soda lands, giving it the appearance of desolation and worthlessness, but, in reality, it is most valuable, as it furnishes substances which cannot be dispensed with in the reduction of silver ores by amalgamation. Along the bases of the mountains are large tracts of valuable farming land, which redeem the valley of its feature of barrenness. The northern portion of the range bears the name of Ruby Mountains, and incloses the famous Ruby Valley, only a portion of which is in White Pine County. No extensive valley appears to be between the White Pine and Egan Mountains, but the many small valleys and rolling hills afford superior grazing and sites for many productive farms. East of the Egan Mountains is the extensive Steptoe Valley, flanked on the east by Shell Creek range. Next follows Spring Valley and the Spring Mountains, Snake Valley and Snake Mountains, Antelope Valley and the mountains of the same name. The eastern boundary line passes through Deep Creek Valley.

Besides the mining districts above mentioned, quite a number of others have been organized, which, although perhaps not located inside the county, are closely connected with it as the starting point for all expeditions, and they will therefore be mentioned in this part of the report.

WHITE PINE DISTRICT.

The opinion in my last report, that the formation of White Pine is a simple and not anomalous one, remains unaltered by subsequent examination. The rocks of Treasure Hill are certainly all sedimentary, and so completely exposed as to dip and strike that nothing more than a careful and patient survey of the surface would be required to determine, with considerable accuracy, the geological section. This is at present, however, subordinate in practical importance to the question of the character of the White Pine ore deposits, and the latter question is to be considered mainly in its bearing upon two vitally interesting matters: the probable form and extent of the deposits already opened, and the calculations or natural indications upon which successful search may be made for new ones. No man can predict the effect which future discoveries and developments may exert upon all present theories, and what I may suggest as my opinion upon the evidence thus far produced does not even pretend to be a complete theory. It seems to me, however, that the following points are indicated with considerable force by the prospecting and mining operations, as well as by the original superficial signs upon Treasure Hill:

1. Many of the deposits are clearly connected with the stratification of the limestone. They follow it and permeate it in such a way as to hint at deposition by means of percolating thermal waters carrying in solution mineral salts, and accompanied or preceded, or both, by jets or springs of solfataric gases, chiefly sulphurous acid. Their regularities and irregularities alike resemble those displayed by ordinary springs of water, permeating the crust of the earth, avoiding some strata, saturating others, filling local cavities and fissures in others. Now, if this theory be correct, it is most likely that its application, as far as the mode of

eposition is concerned, will be found universal in this limestone hill. ifferences in character among the mines must be explained by differences in the mold or form receiving the deposit. I am not prepared to y that there will be found no deep fissure veins in Treasure Hill. heir coexistence with the stratified deposits is possible, but not yet roved, nor do I at present consider it highly probable. The smooth alls running east and west on the Eberhardt mine are susceptible of a ifferent explanation, and one which seems to me more in consonance ith the apparent distribution of the ore in layers in that zone of two undred feet width.

2. Some of the best mines in the district show deposits between a certain belt of arenaceous slate and limestone. The Hidden Treasure, heboygan, Mammoth, and others on the north end of the hill are examples, and one of the remote southern mines, the California, has a hanging all of clay, which may or may not be the equivalent of the same slates. etween these two extremities there are cross-breaks or slides in the imestone, certain portions of which have been elevated more than others, o that the same topographical level or continuous line does not represent the continuity of the same stratum of rock. In many instances a ighly metalliferous layer abuts suddenly upon a smooth wall, beyond hich the lithological character of the limestone appears so different s to suggest that it is in reality the continuation of another stratum, rought opposite to the first by a change of relative position in the rocks.

3. It will be seen that this hypothesis after all involves the recognition f a certain sort of fissures, such, namely, as were formed after the deposits f ore and quartz had been made. If future study should enable us to etermine in each case the direction and extent of movement, one might nd the continuation of such deposits of value as are suddenly thus cut ff; and this question would be of immense importance on deeper workings, since, if this theory be measurably true, there must be accumulations of rich ore in Treasure Hill that do not crop out at all.

4. There seems to be a difference between the ores of the eastern side nd summit, and those of the western side nearer to the so-called Base etal range. This difference may disappear in depth; it certainly might e expected to do so if the deposits were separate fissure veins, but it ives to the former mines at present a very tangible advantage in purity f ore and consequent cheapness of successful reduction.

5. The ores of some of the mines are contained in a peculiar vein matter consisting of breccia or angular fragments of silicified limestone cemented together with calc spar, which generally fills up all the interstices. As this spar never contains any silver ore, (so far as I have been able to earn,) it seems likely that it is the latest infiltration into the mass. The ilver ore, generally in the form of chloride, but frequently as sulphuret, nd even as native silver, is found incrusting the breccia, penetrating the revices in threads and films, and disseminated through the whole texture as well as aggregated here and there in irregular chambers or pockets. However rich the ore may be in such bonanzas, it has never failed o show traces of the usual vein matter, thus indicating that it differs nly in quality, not kind or origin, from the ordinary ores of lower grade. oubtless it would be extravagant for any one to expect the frequent ccurrence of rich bodies like that discovered in the Eberhardt, since xperience has proved such occurrences to be exceptional; but this much ay be said with truth, that the White Pine limestone is a peculiarly avorable matrix for such bodies of ore, and that they may not impossibly occur anywhere in these argentiferous strata, where cavities or fissures large enough to contain them have been formed by the disintegra-

tion or solution or erosion of the rock, and where the metalliferous fluids have had sufficient access. Traces of these conditions would necessarily be found in the inclosing rocks. I should, therefore, not expect to find chambers of rich ore in the hard, dense, non-metalliferous lime, while, on the other hand, I should regard (in default of any more positive indication) a layer of silicious and spathiferous breccia, showing traces of silver ore, as a most favorable locality for their occurrence. It is almost impossible to give anything like a full account of the mining operations of the district. There are now at least ten thousand mining locations made, and it would be the labor of months to obtain even a list of claims which are being worked, and which furnish ore in quantities ranging from small lots of a few hundred pounds per month to twenty, thirty, or forty tons per day. The following notes, furnished by a gentleman in Treasure City, were obtained partly by personal inspection, but mainly compiled from the mention made of the different mines from time to time in the local papers.

LOCATION OF THE MINES.

The White Pine mines are about one hundred and fifteen miles south of Elko, a town on the line of the railroad two hundred and seventeen miles west of Promontory Point, the junction of the Union and Central Pacific railroads. Several lines of stages run from Elko to Hamilton, the county seat of White Pine County; time seventeen hours; fare from $15 to $25 according to the opposition at any given time. The road is over a smooth level plain for about one hundred miles south; thence an easy grade to the mines. There are three or four well-graded roads leading to the summit of Treasure Hill, over which heavily loaded wagons pass without difficulty. Freight from Elko to Hamilton during the dry season is about two cents per pound.

POPULATION.

There are three incorporated cities, Hamilton, Treasure, and Sherman. Treasure, on the summit of the hill of the same name, is the leading business place, although there are probably more people in Hamilton. The principal mines at present are on the top of the hill in and about Treasure City, and the majority of the laboring men of the district are found there. Hamilton, at the base of Treasure Hill, has a more pleasant location, a good supply of water, and being the county seat, and having superior advantages for milling, draws quite a population. No census having ever been taken, the number of inhabitants is not known with any certainty, and is variously estimated. The Inland Empire sets it down at 15,000 for the entire district, an area twelve miles square. This estimate would require a distribution somewhat as follows: Hamilton, 5,000; Treasure, 4,000; Sherman, 2,000; other towns and scattering, 4,000. Many think this estimate is about twenty-five per cent. too high all round. Sherman has the best climate, and is the most pleasantly situated of the three.

YIELD OF THE MINES.

From such statistics as I have been able to obtain, it appears that the total production of silver of the White Pine mines from the month of May, 1868, to the 1st of January, 1869, has been $968,813, and from the two mills at Shermantown, from January 1 to April 1, 1869, $297,023;

; a total of $1,265,836. From the two mills at Hamilton I have eived any returns. The report of the month of March shows a it increase. According to the assessment roll returned by the assessor for the quarter ending June 30, 1869, the ore crushed iirty-four mines, scattered over an extent of country six miles in by three in width, amounted to 4,174 tons, which represented a f $412,814. The average value of a ton was, therefore, $98 82. it be remembered here that during the whole of April and the part of May the actual bullion-producing capacity of the district iited to thirty stamps, while for no part of the quarter over sixty re in actual operation.

following is a complete list of the mines having made returns to essor, the number of tons milled, and the amount of bullion pro-

e of mine.	Tons.	Value.	Name of mine.	Tons.	Value.
	115.1049	$19,333 08	Hidden Treasure, first ex.	19.1721	$2,189 42
	60.0881	11,849 90	Highland Chief	1.1064	146 31
	6.0915	2,926 60	Industry	175.0046	14,688 56
uth	343.0382	22,589 50	Inimportancy	2.0593	217 74
	7.1837	418 04	Keystone	64.0533	12,070 11
onsolidated)	239.0973	10,678 70	Nash and Melleno	.1160	83 86
d Theresa	10.0977	663 66	Pocotillo	7.0032	213 06
ver Glance	7.1850	565 85	Post Hole	215.0000	27,907 00
k	4.0064	233 08	Rattler	105.0785	2,690 00
	4.1659	354 81	Sage Bush	17.1270	784 12
ed Chloride	931.0751	88,132 01	Steptoe	15.1910	478 65
	23.1606	3,177 38	Summit and Nevada	495.0000	32,810 20
	5.1000	165 00	Thunderbolt	3.0299	132 78
	75.0280	4,720 43	Virginia	6.1814	498 10
onsolidated)	14.0149	4,819 31	Willard	2.0015	9,928 73
	744.0000	110,112 00	Zubrick	.1972	197 00
idden Treasure.	428.1091	34,512 78			
	19.0585	1,796 29	Total	4,174.0064	412,814 19

r the law $18 per ton of the gross proceeds of the mines is exempt ixation. This amount deducted, the three and a quarter per ix on the remainder will return $11,093 65, which is the amount nue accruing from the mining tax in this county for the quarter June 30.

eturns made from July 1 to 20 are given in the following:

Name of mine.	Tons.	Pounds.	Yield per ton.	Total.
uth	153		$92 25	$14,114 25
	1	1,550	311 65	553 17
	3	1,000	106 00	371 00
allurgical		548	6,874 19	1,883 50
ed Combination	1	1,000	126 00	189 00
	480		390 00	187,200 00
	2	616	734 83	1,693 98
	5		122 40	612 00
easure	8	1,000	100 00	880 00
Chief	3	500	190 00	617 50
	179		192 00	34,368 00
	14		307 00	4,298 00
i	2	714	296 07	697 83
	12		246 67	2,960 00
	12		126 92	1,523 04
	7	1,500	340 00	2,635 00
		618	299 08	92 51
	2		57 50	115 00
	54		157 60	7,510 40
	5	1,300	120 93	683 24

rding to the statistics gathered by Mr. C. B. Dahlgren, who has nuch time for that purpose, and whom I consider trustworthy authority, the total number of tons worked from and in White Pine up t July 1, 1869, is 8,869.23; value of bullion produced, $2,017,831; averag yield per ton, $227 75; average fineness, .963.

PRINCIPAL MINES ON TREASURE HILL.

In order to describe the location of these mines understandingly, word as to the general configuration of the ground is necessary. Th White Pine Mountain range is quite broad, consisting often of two o three parallel ridges, sometimes quite close together, sometimes sprea more widely apart. At the point where the White Pine mines ar located there is a spread so that the summits of the two nearest ridg on the inside are five miles apart. Right in the middle of the valle thus formed rises up Treasure Hill, 10,000 feet high above the se about fifteen hundred above its immediate base. It is called Tre sure Hill, but it is in fact a very large mountain, which is longest fro north to south. A line drawn through its immediate base from north t south would be about three and a half miles long, and through the bas from east to west about a mile. The summit is about a mile and a hal in length from north to south, and the terminal line of the summit a each end is very plainly marked by a sudden and, at the south end almost precipitous descent. The body of the mountain is composed o limestone strata, originally horizontal, but subsequently raised from th eastern side so that the strata slope now at an angle of about thirt degrees toward the west. The east side is very rough and precipitou as it consists entirely of the jagged, projecting ends or sides of the strat so tilted up. It is true, these are worn off a little by the weather, th action of frost, snow, heat, and rain, which constantly loosen little part cles of the rock. These, borne along by the falling rain and meltin snow, and lodging in convenient places on the side of the mountain, for little banks and comparatively flat places of small area, where the seed of the indigenous pines and mahoganies find room for a stunted growt This portion is called the East Side, and on it are found many min of considerable, and some of primary, importance; among the latt the Hidden Treasure, near the crest toward the northern end, th Emersley, a little below the last, and the Pocotillo, toward the souther end. From the crest to the western base the slope is more gradual, an the surface comparatively smooth, because it is really nothing but th originally flat stratum tilted up from the east at an angle of thirty degree Still, though it may be called smooth as compared with the eastern sid viewed by itself, it is quite uneven. There are two reasons for this first, as the upheaving force was not perfectly equal at all points alon the line, the strata were not uniformly elevated throughout the whol length of the mountain. Wherever the upheaving force was greates the strata are lifted highest, leaving intermediate depressions along th line. Again, there are signs indicating that there was at places such a inequality of force, that the strata broke across from east to west, an either fell back below the level of an adjoining portion or remained st tionary, while the adjoining portion continued in its upward cours Along the sides of these transverse cracks there are signs of the gratin and grinding of the rocks upon each other, and the scratches on thei surface are vertical, showing that the motion which made them wa vertical. At the south end there is a spur and a sudden descent. O the small table-land thus formed, and called, with the neighborhoo the South Side or Sunny Side, is the Eberhardt, and farther down th California, Mazeppa, and numerous other claims. The second caus r the unevenness of the west side is the unequal erosion of the strata. me of the strata exposed by these cross-breaks being softer than hers, wear away more rapidly and leave the surface very irregular. n the west side, beginning at the southern end, is a smooth area called ogonip Flat. On this flat are found the Pogonip, Othello, Glacier, d numberless other mines. Next on the north is another flat, called hloride Flat, where some of the most important mines are located. till further north are Bromide and Bonner Flats. The northern slope the mountain is commonly spoken of as the North End. In the follow-g descriptions mines are variously spoken of as being on the East ide, Sunny Side, North End, Pogonip, Chloride or Bromide Flats; and ference to the foregoing description of the localities will explain their tuation at once. The Base Range, beginning at the foot of the west de of Treasure Hill, runs west along the side of the adjoining moun-ain. Bullion Hill is a little hill about two miles northwest of Treasure ill. Blue Hill is located close to Hamilton. Treasure City is built ong the summit of the mountain, on the west side, near the crest. ain street runs parallel with the crest of the mountain, and is from two three hundred feet from the summit. Many of the mines are on this reet, and shafts are sunk in what should be the sidewalk.*

Aurora Consolidated.—At the south end and on the west side of the mmit, midway between Main street and the crest; one of the leading ines; located in the fall of 1867—about the same time as the Eber-ardt. June 19, 1869, it had 50 men at work, 250 tons of ore on the mp, and was extracting 20 tons daily, which were shipped to the ewark mill, thirty miles distant. The main shaft is down 55 feet. At depth of 30 feet a breast was opened to the north, which, at the time inspection, was 18 feet in, 12 feet high, and 25 feet wide. A shaft rther north, called Last Chance shaft, was 30 feet deep, with a drift nning northerly 40 feet to the Iceberg shaft, which had a depth of 26 et. Thirteen feet east of the Iceberg is another shaft, from which ere was a drift run north 70 feet. Two hundred feet north of the south e is the Protection shaft, 30 feet deep, and in ore. July 3, 1869, the ift connecting the Iceberg and Last Chance shafts completed; drift rtheast from Iceberg, in 90 feet, with an air shaft tapping it at 50 t in. The ore breast south, 30-foot level, showed no signs of depreci-on. July 10, stock quoted at $18. (The company was incorporated San Francisco, December 11, 1868; 16,000 shares; capital $1,600,000.) is company claims that its location covers the Earl mine, situated on in street, and is now litigating title with the Earl claimants. A tem-rary injunction has been laid upon the Earl, stopping it from work.

Aurora South.—Immediately south of the Aurora Consolidated, and ated at the same time. It is 800 feet in length. Prospect shafts have en sunk the whole length of the location, and a continuous deposit of ineral was found from the starting point at the south end of the Aurora nsolidated for a distance of 400 feet. The main works are a few feet uth of the north end of the claim. At this point a large shaft has en sunk, and a drift run from the bottom of it in a southerly direction r about 250 feet. The deposit of ore is considered to vary from 30 to 0 feet in width. June 19, 1869, was working 70 men; at that time ost of the ore extracted was taken from the main shaft, before referred to, at a depth of 30 feet, and from a chamber running east and west. This chamber is 20 feet deep, 20 wide, and 58 in length from east to west. From the west end of this chamber the long drift starts south. This drift was run to "trace out" the Autumn and Highland Chief, two separate claims, which were claimed by the Aurora. Litigation instituted by the Aurora to eject the other parties from the ground was pending. The Highland Chief men, satisfied that they could not hold the ground, effected a favorable compromise, and surrendered their claim. The result as to the Autumn is not yet decided. The main shaft, June 19, was down 57 feet, all in ore. The mine yielded 10 tons daily. At this date cuts were being run to strike the ledge further south. The 25th of June the company completed a shipment of 200 tons to the Big Smoky mill, at Hamilton. About this time the cuts spoken of tapped the ledge some 300 feet south of the main workings, and struck very rich ore, with some horn-silver. The company then suspended shipments of ore, awaiting the completion of the Stanford mill on Sunny Side, near Eberhardt City, and reduced its working force to 40 men, which number, it was believed, would be able to extract 1,500 tons by September 1, the time the mill was expected to be ready. It was not convenient to extract a larger amount, because the dump piles would be too much incumbered. The company is incorporated in San Francisco, and is principally owned by the Stanford Brothers, who paid $120,000, coin, for it to the original locators, one of whom was the discoverer of the Eberhardt. The mine is at present under the superintendence of Dr. Goodfellow, and ranks in public estimation very close after the Eberhardt.

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*Many of the facts herein recited are taken from the notes of Mr. Ginn, the "mining cal" of the White Pine News, and were made up by him from actual inspection of the ines, and published in the News in the form of a weekly summary. They were sub-ct at the time to the criticism of thousands of persons cognizant of the facts, and were iversally received as strictly correct.

Abercorn.—On the south side, below the line of the Eberhardt, and about 40 feet north of the California. June 19, 1869, had a shaft down 12 feet on the foot-wall in ore, and located 40 feet northeast of the main workings on the California. The claim is spoken of as being noted chiefly for marking a distinct line of upheaval in such close proximity to that remarkable mine.

Addington.—On Bromide Flat, May 29, 1869, struck a body of very fine ore in one of the shafts. The two shafts called the east and west shafts are connected at 43 feet depth by a drift. The west shaft is 45 feet deep. Considerable ore was taken from it, but some time before June 26 work was suspended in it and a new shaft was started 50 feet west, which on June 26 was down about 45 feet, without having reached ore. On the 43-foot level in the east shaft a drift was run south in ore, and as late as July 10 they continued to get ore in that drift.

Auburn is next below the Addington; was in ore June 26, some of which was very rich. A quantity of the lower-grade ore, taken from above the rich strike, was sent to the Newark mill to be tested.

Albemarle.—Incorporated at San Francisco, California, March 21, 1869; 12,000 shares; capital stock, $1,200,000.

Blair and Banner State.—At the bottom and on the west side of the cañon leading down between Eberhardt Ridge and Argyle Hill. June 17 a shaft had been sunk through spar and ore to a depth of 23 feet, and about 35 feet from the gulch a tunnel had been driven in which had just tapped the shaft. From 32 feet of this tunnel 40 tons of high-grade ore had been taken. That raised from the shaft was of an inferior quality, being mixed with spar, but nevertheless milled at the Monte Christo mill $93 per ton. Ore shows on all sides in the tunnel. The rock is extremely hard. Ore was sent to mill July 10 at the rate of 12 tons per day. At that date an easterly drift was run from the tunnel, which carried ore; the surface cut running east from the east face of the tunnel was down about 7 feet.

Black Hornet.—On south side, adjoining and parallel to the California. The ground is claimed by the latter company as being a part of its ledge. The owners extracted considerable ore, and then bonded the property for sale. The question of title was not settled up to July 10, 1869.

Bourbon.—June 19, had a shaft down 28 feet, from which an incline 31 feet long had been sunk. A fine body of ore was here met with, 20 tons of which were shipped to the Big Smoky mill.

Bromide Tunnel Company.—Incorporated at San Francisco, February 27, 1869; 30,000 shares; capital stock, $3,000,000; stock quoted July 3 at $3 80. These tunnel companies are organized for prospecting purposes. They select what is supposed to be a favorable location, and then run a tunnel into the mountain, expecting to strike some deposit of ore which does not cross or has not been located on the surface. Such deposits or veins are called blind ledges, and if any are discovered by the workings of such a company they become its property.

Burns.—On Chloride Flat. Struck ore at 19 and at 30 feet depth. July 10, commenced drifting southeast at a depth of 19 feet, at which point they had two feet of good ore in the shaft.

Consolidated Chloride Flat Company.—This company has one of the best properties in this region, and conducts its business on as large a scale as any company in Eastern Nevada. Their mines are all situated on Chloride Flat, in the southern part of Treasure City, near Main street. The Bank of California is generally supposed to be the prime mover and largest owner in the company. The first rich discoveries made on Chloride Flat were taken up by the Gennesee, Indiana, Stonewall, and several other companies. The moment the rich ore was found a thousand other locations were made in the immediate vicinity. Hundreds of shafts were sunk and almost every one of them struck rich ore. Soon the theory was started that the ore in that section was deposited in horizontal strata, extending underneath the whole flat, and consisting of successive layers, one underneath the other, separated from each other by sheets of limestone. In the midst of the general excitement the agents of the Bank, it is said, quietly began searching the records of location. They soon found that about a dozen old locations were made a year and a half before the excitement began, and that most of these locations called for four or five hundred feet each way from the notice, sufficient to cover the richest portion of the flat if they could be all consolidated into one company. They hunted up the owners of these old claims and quietly purchased them all. When these preparations were fully completed, they consolidated all the titles into one company and began work upon the old locations. Wherever they saw a promising mine in the immediate neighborhood, within the radius of any of their claims, they ran a drift into it immediately, and ran the occupants out. By reason of this peculiar system of working they have the ground completely honeycombed underneath quite an area. They have some three thousand feet of tunnels already run and still the work goes on. The ore is connected throughout all these workings. Much of the ore is exceedingly rich; portions of it sometimes yield as high as eighty-five per cent. of its weight in silver, or something like $27,000 per ton. This company employs more men and raises a larger amount of ore than any other in the district. The force employed varies from one hundred and twenty to one hundred and fifty men. The average daily yield is about forty tons of ore. Nearly all of the ore is packed to the mill on mules. The sight of the long trains filing through the streets, urged on by their swarthy *arrieros*, would make a Spanish miner feel quite at home. The bulk of the workings are very near the surface, the greater portion being on the 30-foot level. The ore is hoisted through a dozen or more different shafts, which also serve for ventilation. The Gennesee is the deepest shaft. It was down 145 feet July 10, and most of the way through ore; good ore is found in the bottom. The intention is to drive the shaft on steadily until a depth of 500 feet is reached. The stock sells for from $12 to $13 per share. The company was incorporated in San Francisco, California, December 23, 1869. Fifty thousand shares, capital stock $5,000,000; $12 per share would be $600,000 for the mine.

California.—This is the most noted mine on the south side below the Eberhardt. It was bought from the original locators in July, 1868, by John Moffet, and by him sold to one of the Stanford brothers, of California, in December of the same year, for $50,000 coin. At the time this price was paid for it there had not been much over $1,000 worth of work done on it. The Stanfords began stripping the dirt off the ledge, and very soon uncovered it for 400 feet in length, finding it very uniform in its course and width. The mine is situated about one mile south of the Eberhardt. It is 50 feet wide; hanging wall, red shaly rock; foot-wall, limestone. The ore is rich in chloride and bromide of silver. There is more of the latter present at this mine than in any other mine in the district. The crushed ore, up to May 13, yielded from $300 to $1,000 per ton. The course of the "vein" is east and west; the dip 48° south. Much of the ore resembles the cinders of a blacksmith's forge, mixed with ashes. The company has never employed a very large force of men in the mine, as they have been busy since its purchase erecting their mill at Eberhardt City—the Stanford mill spoken of in connection with the Aurora South. June 19 they had 400 tons of ore on the dump, besides 100 sacks of 175 pounds each of selected ore, worth $1,000 per ton. July 2 the last of 120 sacks of this rich ore was shipped to the Big Smoky mill for reduction. It was expected they would have 2,000 tons of the average-grade ore ready for the mill September 1. The mine is worked by shafts and connecting drifts. Incorporated January 29, 1869; 15,000 shares; capital stock, $1,500,000; 800 feet in the location.

Comstock.—On south side, in Mahogany Cañon, below the Evening Star and Banner. The company owns three ledges, all in slate. A tunnel has been run on the middle ledge. Some very rich chloride ore was found, several tons of which have been smelted at Shermantown.

Constitution.—On Pogonip Flat.—June 19, had a shaft down 20 and an incline 30 feet. Both are connected by a drift 30 feet in length. A fine body of ore was exposed in the breast to the west, and about 30 tons were on the dump.

Copper Glance.—On Argyle Hill.—"Vein" claimed to be 100 feet wide. The shaft, 55 feet deep, passed through three feet of good ore, at a depth of 45 feet.

Crow Wing.—On Chloride Flat.—The shaft is 28 feet deep.

Cora.—On Mazeppa Flat.—The shaft is 55 feet deep, and exposes ore the same as a drift once forced it northward.

Cerro Pasco, on Radical Hill, has followed a beautiful foot-wall, with an incline 49 feet deep, through a body of fair ore, the entire distance.

Charter Oak, belonging to the White Pine Mutual Milling and Mining Company, is situated on the east side, toward the north end; adjoins the Emersley, of which it is a continuation, and is almost due north of the Hidden Treasure, and about 500 feet below the summit. May 17 the shaft was 50 feet deep, and contained good ore all the way. A rge amount has been reduced at their mill, in Hamilton, parts of which elded $450 per ton. Some of the ore found at 50 feet depth has a ght yellowish green color when taken out, but on exposure to the sun changes to a purplish hue. The mine is owned in Philadelphia, and as located June 10, 1868. It contains chloride and sulphide of silver. he vein is believed to be 30 feet wide. July 10, 1869, the shaft was own 70 feet. The north drift, in 12 feet from the 35-foot level, was in 60 ore.

Casteel.—Claimed to be an eastern extension of the California. Struck e similar in character to the California on June 30.

Chester.—July 10, had out 20 tons $115 ore from a shaft 42 feet deep, cated on a vertical ledge 3 feet wide.

Dell.—June 10, had eighty tons of ore on the dump; shipped 25 tons ree days before; was taking out about 4 tons daily. The shaft is round nd vertical, 20 feet in diameter, and 24 feet deep. A drift to the north as in 14 feet in a large body of fine ore.

Double Eagle.—Property of the White Pine Mutual Milling and Mining ompany, near Virginia street, between Main and Union. Found good re at a depth of about 20 feet. The shaft is being sunk deeper.

Doran.—Owned by Pogonip Silver Mining Company, J. R. Murphy, perintendent. Struck ore at 38 feet, which ranged from $236 to $722 er ton. Drifted on this awhile, and then continued sinking. The vein tands nearly vertical.

Dreadnaught.—On south side, near the head of Mahogany Cañon, on he eastern slope of Eberhardt Ridge. July 3, had a shaft 20 feet deep, etween smooth walls 7 feet apart, and nearly vertical. Quartz and ome chloride are found in the bottom.

Eberhardt.—This being the leading mine of a district which is attracting so much attention, a full description of it will be given here.

Just at the south end of the summit of Treasure Hill seems to have een an immense break running east and west across the strata. A hasm 200 feet wide was opened. The ground to the south of this hasm is several hundred feet lower than that immediately north of t, and lies for some distance comparatively level. In this chasm the Eberhardt mine is located. The deposit of ore and gangue fills the hole of the opening made by the break. The gangue is composed of mestone, quartz, and spar. The ore proper is very irregularly deposted. lying sometimes in horizontal sheets, occurring at other times in he shape of large pockets of all shapes. Large lumps of pure chloride of ilver, some of them weighing over a hundred pounds, are found so pure hat a nail may easily be driven into any part of them, the same as into bar of lead. A silver coin laid upon these pieces and struck smartly ith a hammer or sledge will leave its impression as distinctly as a seal n soft wax. While there is a large amount of this exceedingly rich re, there is a hundred times the quantity of ore of ordinary richness, ay worth $100 per ton, and this, like in all mines, must be, of course, he main reliance for the profitable working of the mine in the future.

The ore was found very near the surface. The first work done was ltogether by open cuts and sinking directly on the surface, the same s in a stone quarry. Hundreds of thousands of dollars were taken out n this way. Then shafts were sunk and drifts run. The main shaft is own now about two hundred feet; it shows no particular variation in he manner of deposition of mineral. No bodies of ore equal to that ut by the first workings were found in the shaft. Of course, this does ot at all go to prove that there are no other such bodies in the ledge, imply because there is no particular reason for their occurring at any particular place except the fact that cavities large enough to contain them must have existed at the time the ore was deposited. The location of these cavities is accidental, and though one shaft might be sunk one thousand feet without striking one, another shaft a few feet distant might cut numbers of them. Probably the best way to find them is to follow the threads of mineral through the vein matter, which probably connect the larger bodies. On June 19 the mine was employing eighty men, twenty-one of whom were employed on dead-work. Twenty tons per day were being taken from the face of the hill and five tons from the mine; twenty of which were only sent to the mill. The Keystone shaft on the north wall was down 200 feet and was still in good ore. A drift driven a distance of 180 feet west from this shaft showed ore the entire length. The Blue Bell shaft on the south wall was down 190 feet. July 3 the mine was sending 22 tons of ore to mill per day. About the same amount was raised. Seven tons of it (very rich) were daily taken from a chamber immediately north of the Blue Bell shaft. This chamber was then 100 feet long, 30 feet wide, and 13 feet high; its base being 40 feet from the surface. The south wall is nearly perpendicular, while the north wall dips south at an angle of 82°. The drift running west along the north wall from the Keystone shaft is 80 feet below the surface and was (July 3) 180 feet in length, showing a seam of clay about two inches thick along the wall. At that time work was suspended on the drift. From the same level in this shaft a drift was being pushed south in the direction of the Blue Bell shaft with which it is intended to make another connection on that level. From the Blue Bell shaft on the south wall, at a depth of 187 feet, another drift is being run north to the Keystone shaft. There will then be three connections from the north to the south wall, a distance of 200 feet between the Keystone and Blue Bell shafts, viz: at the respective depths of 40, 80, and 187 feet. July 10 the usual amount of 22 tons per day was still being sent to the mill. At this date they had 100 tons at the mill and over 300 tons on the dumps. The capacity of the company's mill at Shermantown is 14 tons per day. In the Keystone shaft a large body of high-grade ore is met with at a depth of 165 feet, while the bottom is also on ore, less concentrated but of good quality. This shaft will not be sunk deeper at present, as the depth already attained is very trying to a common windlass and rope. The Eberhardt was the first mine in White Pine to reduce the wages from $5 to $4 per day. This was done in July, 1869. A strike and some trouble for a few days followed, but order was soon restored. The mine and mill were incorporated in San Francisco, California, March 6, 1869; 120,000 shares; capital stock, $12,000,000.

Evening Star.—South side, in Mahogany Cañon, near Blair and Banner State; incorporated; 40,000 shares; capital stock, $4,000,000. Ledge was stripped to a width (or length) of 140 feet and no boundaries found. In general appearance it resembles the California, but the ore is different and seems to be richer. It is spoken of as the largest compact ledge in the district. June 26, had a cut 30 feet long, 12 feet wide and 9 feet deep in ore, in which horn-silver was freely distributed. The company, as at present organized, is a consolidation of the Evening Star and Mahogany mines. Mr. Greenleaf, formerly of the California mine, is conducting the works. Up to July 10 the workings were most satisfactory.

Eastern Slope Tunnel Company.—East side of Treasure Hill, about 800 feet below the summit and directly opposite Treasure City. Location made December, 1868; work began March 2, 1869. May 30, in 150 feet. The first 100 feet passed mostly through slate, which, in some ces, was very hard, in others, damp and soft. June 16, the second 100 t were completed. The tunnel here passed through a formation of estone, mixed with spar. Here and there small cavities exist in the estone, and extensive seams intervene between the rock and spar. e mouth of the tunnel is east of the main line of upheaval of Treasure ll, as shown in the tunnel, where, for the first 100 feet, the rock dips st, and then changes to the west, dipping with the body of the hill. st of tunnel, $15 per foot for the first 150 feet, which is cheaper than mmon. Incorporated in San Francisco, California, February 7, 1869; ,000 shares; capital stock $1,000,000.

Excelsior.—North end, below the Mammoth; 800 feet. Located Decem- r, 1868. Owned by Dunne, Moffett & Freeman; 8 feet wide; dips st 30°. Has all the appearance of a fissure vein. Shows a fine body vein matter, principally composed of spathiferous breccia, mixed with gular fragments of silicified limestone. Ore assays from $50 to $5,000. loride of silver (horn-silver) is found in it, which will assay $20,000 the ton. The location is exceedingly favorable for working.

Excelsior.—On the west side, toward the north end, below main street, d just below Rice's toll-road; 800 feet. Located November 12, 1867. dge runs east and west; stripped 250 feet. On the east end of this ripping, a drift has been run about 20 feet along the ledge. About feet west from this, a drift is being pushed north into the hill, the ttom of which is in vein matter, quartz, and spar, for its entire length, feet. The ledge is nearly horizontal for some distance in, appearing dip at a greater angle toward the western end of the claim than else- here. There are three north drifts from the east and west cut, only e of which is being pushed at present—the most easterly. The other o are in, one about 25 and the other 20 feet, both on the ledge. Con- derable low-grade ore has been taken from the mine. Incorporated; pital stock $1,600,000.

Eclipse Consolidated, (Eclipse and *Umatilla.)*—June 26, had 500 tons ore out, 5 tons of which were sacked for shipment to San Francisco. his lot was estimated to mill over $1,000 per ton. Main shaft, 75 feet. ssing through a fine body of ore at the surface, it penetrated solid estone for 50 feet, and again struck into ore. It is now being pushed ith the intention of sinking to a depth of 200 feet. East drift in 93 et, all the way through vein matter, mineral, and spars. South drift 70 feet; July 10, the shaft had reached a depth of 82 feet, and struck me rich ore in the bottom.

Emersley.—East side, below Hidden Treasure, south of Charter Oak, nother location in the same vein.) A very large vein running rth and south, and dipping west, 800 feet in the location. June 26, s reported to have been sold East for $80,000. It is considered to be ll worth the money.

Eggleston & Brown.—Located July 22, 1868, on north end; July 3; incline to the west had followed down on the foot-wall at an angle of to a depth of 23 feet, where vertical sinking was commenced, the ge being found to stand perpendicularly at that point.

Glacier.—On the brow of the mountain at the commencement of the thern slope, directly west of the Eberhardt, and commonly thought be in the same transverse fissure, the ore resembles that from the erhardt. Location 1,600 feet, beginning at the westerly line of the t west extension of the Eberhardt. Bordering it on the north is a ge limestone cliff which forms the north wall of the great Eberhardt e, and which there is every reason to think constitutes also the north ll of the Glacier. The mine is owned principally in the East, being the property of the White Pine Mutual Milling and Mining Company, and work is being vigorously prosecuted. June 19, had a 35-foot shaft in a 10-foot body of fine ore. The incline from the west was down 20 feet between two well-defined wells lined with clay; but the fissure seemed to have lost its ore near the surface, which had given place to fragments of limestone and spar. Next to the north wall in the incline, ore and more compact vein matter was appearing. June 26, the incline was down along the north wall 14 feet, still in hard limestone with seams of spar.

Gold Hill.—June 19, had penetrated a cap of limestone with a 12-foot shaft, and struck a body of good ore.

Georgia.—Mahogany Cañon, on south side.—June 19, had a cut along the ledge 140 feet, shaft 35 feet, and a few tons of good ore on the dump. June 26, struck good ore at 38 feet in the shaft.

Great Union Tunnel Company.—Three thousand feet square. Located February 22, 1869, on east side, 2,000 feet below the summit, opposite the center of Treasure City. Incorporated in San Francisco, California; 60,000 shares; capital stock, $6,000,000. Some of the heaviest capitalists of San Francisco are the locators. Tunnel was in 100 feet June 15, and work going on.

Good Omen.—East side, on Pocotillo Flat, just south of the Pocotillo mine. June 19, was idle, with a small quantity of good ore on the dump, which was taken from the west drift at the bottom of a 16-foot shaft.

Guardian.—East slope above Pocotillo Flat, a little north of the line of the Eastern Slope Tunnel Company. July 3, had a cut of 18 feet, bottom and sides in good ore; 6 tons on the dump. It is a "protection" location of the Sentinel mine; both owned by the same parties and treated as one property. July 10, was building up a large dump of pay ore. Had a shaft down 12 feet, and intended to begin work on the Sentinel shaft soon.

Grattan.—July 3, was taking ore (mixed with base metal) from a 30-foot breast.

Hidden Treasure.—This was the first mine discovered on Treasure Hill. The locality was shown to A. J. Leathers, the blacksmith of the Monte Christo Company, by an Indian. But the unusual formation of the deposit bewildered him so, that for fear of missing the ledge, he did not locate his claim until the middle of September, and not before he had drawn Mr. Marchand, the superintendent of the Monte Christo Company, into the secret.

When the Eberhardt and other mines were discovered, the excitement began, and the district was soon filled with people. The Hidden Treasure still holds its rank as one of the first mines in point of value as well as discovery. It is worked mainly by open cuts, and the deposit lies between a stratum of clay slate above and limestone below, its dip necessarily following that of the strata on the hill. It crops out on the east side of the summit very near the crest, and at that place lies quite flat. It has been stripped for 600 feet in length, and many large excavations have been made. The ore abounds in horn-silver, and as at present opened the mine can easily raise 100 tons per day. The shipments during the past summer have varied from 10 to 40 tons per day, most of which were packed on mules. It is difficult to give the thickness of the vein; one cut run across it seemed to indicate a width of 97 feet, but that inference was based upon the supposition that the dip was forty-five degrees. If the angle of the dip should be less, as is almost certainly the case, the length of the cut would give the real thickness of the deposit considerably too high. However, the vein is large enough to satisfy the most rapacious company which ver mined for silver. A tunnel was in, on June 26, 98 feet. Surveys indicated that 52 feet more would strike the ledge at a depth of 200 feet from the surface, but this is again based upon what is probably a false supposition of the dip. The open cut has been run across to the west or hanging wall, and the whole body of the ledge thus exposed is being breasted to the south by open work. July 10, the south breast was not yielding as well as it had been, but a new deposit was found west of what had been supposed to be the west wall. A suit is pending for a large portion of this mine. The locators of the Hidden Treasure complied with the laws of the district in putting their notice on the ground, but it is claimed that they did not cause the same to be recorded for a long time after the ten days which are allowed by law from the time of posting the notice. The locators of the Rathbun mine near by, thinking they had a point on the Hidden Treasure in this, ran their claim over a portion of the Hidden Treasure ground (I think about four hundred feet) and got their claim recorded first. The Hidden Treasure being in possession, instituted an action to quiet title, thereby compelling the Rathbun men to go to their proofs and defend their claim or forever after hold their peace. The Hidden Treasure men, while they admit the patent fact that their notice was not recorded in time, claim that it was delivered to the recorder before the Rathbun notice, and that it was mere inadvertence in the recorder to enter the Rathbun notice out of its order, and that they cannot be made to suffer for this fact. The matter will probably be compromised after a strong show of fight on both sides, as it is very dangerous work to litigate at title in White Pine where so much is involved. Both parties are generally taken very much by surprise by the testimony introduced before they get through. It is astonishing how witnesses will turn up who happen to know always just what is necessary to suit the particular wants of the case. The stock of the Hidden Treasure stands pretty firm at $30 per share. There are 16,000 shares, which puts the present market price of the mine at $480,000.

Hidden Treasure Consolidated is the first extension north of the Hidden Treasure. It has been pretty well prospected and the ledge uncovered about one hundred feet. June 4, they had 50 or 60 tons of ore on the dump, which resembled that from the original. Two inclines are being sunk with satisfactory results. The ledge improves, so far, in width and appearance, and there is scarcely room for a doubt that it is the same "contact vein" opened in the original, as it rests on the same bed of limestone and has the same clay slate above. There is no indication between the two mines of any disturbance. July 10, the mine was looking well; both shafts had got into fair ore. The incline was down [illegible] feet, at which depth a winze had been sunk eight feet in a mixture of limestone, quartz, and spar stained with chloride. North shaft down [illegible] feet in ore. Incorporated; 12,000 shares; capital stock, $1,200,000. Stock holds pretty steadily at $2 50 per share.

Hidden Treasure South.—Working steadily with good returns.

Horseshoe.—South side near Mazeppa. May 9, opened a splendid breast of horn-silver. The incline is down 71 feet, pointing toward the Mazeppa; all the way down it is on a good foot-wall and through good ore. This foot-wall is said to be the finest in the district; it dips forty-seven degrees. The ledge is seven feet wide and a model for compactness and uniform grade of ore. The bottom of the incline rests against limestone, 12 feet of which separate the Horseshoe from the Mazeppa shaft. On June 26 ten tons of good ore were on the dump.

Herman.—June 26, had a shaft 40 feet, following the hanging wall.

Here a turn was made through the wall into the ledge, and 20 feet of good ore were penetrated. The east shaft in the foot-wall is claimed to show the ledge to be 80 feet wide.

Hydrogen.—South side on a ridge east of the California. Shaft 22 feet down a slightly-inclined hanging wall, smooth as sheet iron. A drift has been run ten feet northeast from the bottom of the shaft through a mixture of limestone and black spar.

Hemlock.—July 3, was sinking and drifting in ore. Fifty sacks were on the dump and a large body in sight. July 10, was running a cut east and west, south of the shaft, which showed ore of good quality within three feet of the surface for its entire length.

Hornet.—A few hundred yards west of the toll-house on the road from Hamilton to Shermantown. One thousand feet; sold in the winter of 1868–'69 for $3,000. Was working well May 20, 1869, and work going on. The ores are chloride and sulphuret of silver. The mine is said to be entirely free from conflict of title with any other claim. July 3, had an incline down 35 feet, and a large quantity of fair ore on the dump.

Industry.—On Main street, near the south end of the summit above Chloride Flat; incorporated at White Pine; 20,000 shares; capital stock, $2,000,000. It is the pioneer home incorporation at White Pine. In the week ending June 19, 1869, it shipped bullion to the amount of $5,312 38. The shaft at this date was down 35 feet, where a large chamber has been opened in a fine body of ore. The fineness of the bullion from this ledge is remarkable, one bar assaying .989 and three bars .991, or one above the government standard. At this time the mine was raising 8 tons daily, which were shipped to McCone & Dunn's mill.

July 26, it was raising 10 tons daily; $1 per share was offered for the stock in the board. The force was increased. June 30, the first dividend was declared. A threatened contest of title with the Nevada Company was, during this week, avoided by compromise, without expense to either company, and the Industry title was at that time considered unclouded, and the boundaries established and admitted. July 10, yielded 5 tons daily, and had 35 or 40 tons on the dump. Three breasts were being pushed on the 35-foot level to the north, east, and west.

Indianapolis.—July 10, had a shaft down 73 feet, from the bottom of which a drift was run 13 feet north across the ledge, through quartz, which carried some ore.

Ince Hall.—East side south of Pocotillo Flat. Shaft down 41 feet on June 26. Some good ore struck.

John Dare.—East side, on the upper or western Pocotillo Flat, or rather above the flat. A large shaft was originally sunk on this mine to a depth of 25 feet, from which a quantity of good chloride ore was taken, but the location not being favorable for working, a cut was commenced lower down the hill on a level with the bottom of the shaft. It was an open cut for a distance of 20 feet into the hill, when a drift was commenced. July 10, cut and drift were in 27 feet, leaving 17 feet to penetrate to the bottom of the shaft. The principal place of business of the company is San José, California.

Johnson Tunnel.—July 3, was running for the Relief and Cuyahoga ledges. Open cut 28 feet into the hill; from this point a tunnel was in 46 feet.

Keblah.—The most elevated mine on Treasure Hill. June 26, the shaft 26 feet deep, exposing some pay ore. It is the property of the National Milling, Mining, and Tunnel Company, and the National Tunnel starting in on the eastern side of the hill on a level with the Eastern Slope Tunnel Company's works. is driving, among others, the ledge of his company. This mine is located 9,260 feet above the sea. July 10, ore of improved quality was mined. Shaft was 32 feet deep.

Leviathan.—Eastern slope of Argyle Hill. June 26, was taking good ore from a shaft 26 feet down.

Lincoln.—June 26, shaft was 50 feet deep. Two drifts are run from t, one at 25 feet depth, (in 15 feet,) the other from the bottom, (in 14 eet,) both following the ledge between the walls.

Lexington.—In the first sag of the Eberhardt Ridge. Shaft 40 feet deep. July 9, was sinking the shaft deeper.

Mazeppa.—On the south side, below the California, and southeasterly rom it, in the cañon leading to Eberhardt City. It is considered one of he leading mines of that neighborhood. June 19, was working in rich re. An incline from the old shaft had reached a depth of 28 feet, where 9-foot breast was being pushed into the rich ore. June 26, the prinipal work was done at a depth of 23 feet; on this level a breast 15 feet wide by 8 feet in height had been pushed 15 feet to the north in a large ody of good ore. To the west another breast 15 feet broad by 12 high ad been driven 20 feet, descending gradually with the dip of an apparnt foot-wall which is, in fact, only a stratum of limestone separating he upper deposit from one beneath, which has been cut by the shaft. The west breast was all ore, save the limestone under foot, and of a igher grade than that in the northern one. The principal work was hen being done west, and the intention was to broaden the breast into vast chamber, with sufficient pillars left to secure the roof. July 3, inking in the shaft was continued with the intention to go down 40 feet. The west breast, 23 feet in, was being cleared preparatory to sinking an ncline. Work in the north breast was stopped. The intention was to open another chamber at a depth of 35 feet beneath the layer of limestone, on top of which breasting was then carried on. The shaft which had penetrated this stratum was in good ore July 10. The west ore breast had been followed to a point where the limestone stratum beneath (penetrated by the shaft) had changed into a red conglomerate of lime spar and quartz, carrying chloride. Workings showed the ore under this stratum continuous and good. This Mazeppa is not incorporated. The incorporated Mazeppa quoted on the San Francisco stock board is an undeveloped extension.

Mahogany.—South side, 1,500 feet below Eberhardt. This company is a consolidation of the Stewart, Evening Star, and Mahogany ledges, the Stewart and Evening Star being about 500 feet above. June 19, had a 10-foot drift leading from a 30-foot cut into a rich body of horn silver.

Mecca.—June 19, shaft, 25 feet, thence a drift 8 feet through ore; 28 tons of ore on the dump.

Manhattan.—Western slope of Argyle Hill, owned principally by T. Murphy, former owner of the original Hidden Treasure. Two parallel inclines were first sunk 30 feet deep on the foot-wall, then connected at the bottom by a drift from which rich chloride and stelefeldtite were taken. Ledge claimed to be over 100 feet wide. June 19, had 20 tons of ore on the dump. June 26, working force was 25 men.

Mechanics.—South side between Eberhardt and California. June 3, shaft 42 feet deep.

Misolony Tunnel.—July 3, was in 51 feet, inclining downward. It showed some quartz and spar on the north side near the face.

McLane.—July 3, had a tunnel 50 feet long and a winze of 23 feet in depth; still in limestone.

Mammoth.—The leading mine on the northern slope of Treasure Hill, (the Virginia not being exactly on this slope.) This ledge was located in July, 1868, but was afterwards sold by the original locators to a San Francisco company, and is now owned and incorporated by them. The dip and strike of the vein is similar to that of the Hidden Treasure and the principal mines of Chloride Flat. The width of the vein is as yet unknown. The company, in order to ascertain the width of the pay streak, have sunk seven shafts, one above the other, each shaft being from 8 to 20 feet in depth, and have struck good ore in each. A cross-cut has been made, running immediately on the top croppings of the vein, but as yet not across the ledge. From the number of shafts sunk and the cross-cut run, it is believed that the ledge cannot be less than 300 feet in width. There is ore enough now in sight to warrant the company in any expenditure for mills or improvements on the mine. A daily force of 15 men is at present (June 3, 1869) employed in taking out ore. Not less than 200 tons of ore are now lying on the dump. Quite a number of assays have been made, none going under $100 per ton, and some as high as $1,000—the ores showing an abundance of chloride. As work was only commenced in February, 1869, considering the inclemency of the weather, great progress has been made in the way of developing this mine. The company think the amount of ore now on the dump will warrant them in erecting a mill. James McQuaid is superintendent. The Mammoth is well and truly named, being not only of immense width, but having thousands of tons of ore in sight that will mill from $100 to $500. Incorporated; 36,000 shares; capital stock, $3,600,000; stock stands about $2 50 per share. The Sheboygan, a somewhat noted mine east of Mammoth shaft, was lately absorbed by the Mammoth Company.

Noonday.—On Chloride Flat. June 26, had a drift south 200 feet, with a cross-cut 100 feet from the mouth. The latter runs 40 feet east and 15 feet west from the line of the drift. Many other cross-cuts, shafts, drifts, and winzes have been run. July 10, extensive prospecting was carried on, with good result.

Nightingale.—June 26, had a shaft down 40 feet through black spar and some ore.

Napoleon.—June 26, a tunnel 37 feet long and a winze at the end 24 feet deep, were in vein matter.

National Tunnel.—(See Keblah Mine.)

Oakland North.—On Lower Chloride Flat. July 3, shaft was 30 feet deep, at which depth a drift was run east 12 feet through ore.

Oakland.—On south side, a few hundred feet west of Mazeppa, and about 2,000 feet south of the California; located December 20, 1868. July 3, the shaft was 47 feet deep in 4 feet of quartz and chloride.

Old Ned.—July 10, had suspended operations in the south drift, (34-foot level,) and had commenced drifting in the same direction on the 50-foot level. In the 34-foot drift the ledge was standing almost vertically.

Omega.—Northern slope on a line between the Hidden Treasure and Mammoth. June 26, the shaft was down 85 feet in 5 feet of ore, mixed with black spar and quartz.

Othello.—(See Pogonip and Othello.)

Pogonip and Othello.—On Pogonip Flat, at the south end of the summit of Treasure Hill; located November, 1867. Several locations in this vicinity have been purchased by San Francisco capitalists, and all consolidated under the name of Pogonip, (the Piute Indian word for fog.) Sometimes the claim is spoken of as Pogonip and Othello, the Othello being one of those locations. Some wonderfully rich strikes have been made by this company, and the mine is considered one of the leading ones. June 19, had 300 tons of ore out awaiting the completion f the company's mill, which was expected to start up about the 20th of uly. The entire 800 feet of the claim had been cut through, and rich re was found in all parts of it. North incline 20 feet deep; middle and iain shaft 20 feet, with a drift to the north 25 feet, leaving 35 feet yet) connect the two shafts.

The south line shaft was down 18 feet, and from this a drift ran north 0 feet, all the way through ore. All these shafts are upon a line, while he Othello shaft is 30 feet west, and was then 30 feet deep. Two drifts 'ere being run from the Othello to strike the main drift connecting the ther shafts. The ore from the Othello is exceedingly rich. June 26, he stock of the company had been listed by the board in San Franisco, and quoted at $16. A body of rich ore was struck in the north haft, resembling that from the Othello. July 3, stock opened at $20, losed at $19.

Pocotillo.—East side, south end, on a flat of the same name. Quite noted mine. Work was suspended for some time, on account of litiation. Resumed June 19. July 3, stock stood at $8; 14½ tons of ore 'orked at the Treasure mill gave a pulp assay of $225 to the ton. This 'as from the original working of the mine. Workings about this date isclosed the fact that the main body of ore lies south of where the mine 'as first opened and pitches north. The old pit (first workings) is about 5 feet square and 12 feet deep. In the south face the ore is rich, 7 feet p from the bottom, but dips towards the north at an angle which rings the rich stratum to the bottom at the north side of the pit.

Phil. Sheridan.—East side, at the foot of the slope toward the north nd, at the foot of Treasure street. July 3, working in $119 ore.

Post-hole.—On south end of Chloride Flat. June 19, had 30 men enaged. Shaft 24 feet, drift east and west 78 feet. Raising 10 tons daily, 'hich milled from $100 to $600. June 26, had added 5 feet to its east nd west drift, on the 24-foot level, and raised and shipped 5 tons daily f $100 ore; 50 tons still on hand. July 3, had sent 101 tons of ore to iill during the last week, which averaged, second class $150, first class 350. This company has traced out the Alturas, and is now running iat shaft also, taking out 7 tons daily from a breast 20 feet wide, ttending along the connecting drift. July 10, extracting and sending) mill 10 tons per day, and drifting north and south in ore on the 25-ot level. No richer ore has ever been found in White Pine than that ikeu from the Post-hole. The mine stands among the very first on reasure Hill, but there has been great uneasiness felt about the title, n account of a claim made by the Nevada Company, which is said to ave an older location. On the 30th of June the following notice was ublished in one of the local papers as an item of news:

> "COMPROMISED.—The Nevada, (Treasure Hill Mill and Mining Company,) Industry od Post-hole mines have come to an amicable adjustment of title, by which the three o ahead with work without further danger of litigation. The Post-hole and Industry ıch made a separate arrangement with the owners of the Nevada, and everybody is itisfied, so far as we know, except, perhaps, the lawyers."

But whether that arrangement gives the Post-hole its ground or only ermission to work it six months or less, the notice does not state, but 'herever the title goes it takes with it a wonderful mine.

Pasco.—June 19, shaft, 35 feet; good ore, which was sacked for shipıent. July 3, sent 10 tons of ore to mill, and had as much more on the ump. Drift southeast from bottom of shaft, 12 feet, through good ore.

Paris.—July 10, struck a body of good ore on the south side of the cline.

Pennsylvania.—On summit of ridge south of original Hidden Treasure, 400 feet in the location; located July 22, 1868; at work July 3, in a cut on the north line of the claim.

Rattler.—In the southern part of the town, near Main street, in the neighborhood of the Post-hole. June 19, had 33 men at work; shaft down 35 feet, 11 feet in ore; driving a breast north 8 feet high, 20 wide, all in ore, and drifting west at the same time. East drift in 6 feet, with the whole face in ore; 120 tons ore on the dump; 9 tons hoisted daily, and about the same amount shipped.

Ravell.—East side on Pocotillo Flat next south of Little Phil. Sheridan. June 19, struck ore at 15 feet depth.

Rathbun.—At work June 19. Shaft closed to outsiders. Stock sold in local board during the week at $4.

Red Jacket.—Near the Eberhardt, said to be about 30 feet wide. June 26, shaft 8 feet in decomposed spar and red quartz. July 3, shaft 13 feet in black spar and quartz, having passed through the red rock and 3 feet of decomposed spar and apparently reached a solid formation.

Sagebrush.—On Main street. July 10, opening new levels at 35 feet depth and sinking. A drift was being run to the Post-hole for air.

Sunny Side.—June 26, still drifting east and north from the east shaft at the 36-foot level. East drift in 12 feet with some ore. The north drift struck a curious formation, a large mass of fine powder resembling ashes, and containing a large percentage of chloride; 25 tons of ore on the dump.

Silver Ware.—In the northeastern portion of Treasure City, among the private residences, a little southwest of the south workings of the original Hidden Treasure. July 3, was quite active in the board opening at $13, closing at $10. Two shafts 100 feet apart, the west one down 23 feet through slate, temporarily closed, and the east shaft down 40 feet with a drift on that level running west of north, in good ore; 20 tons on the dump.

Saskatchewan Tunnel Company.—On Bromide Flat, back of Hallock & Meyer's store, and 100 yards down. June 19, in 80 feet, from which point a winze has been sunk 40 feet, (120 feet from the surface.) A large amount of ore is in sight and some on the dump.

Second of May.—Northeastern slope Pocotillo Flat, June 29, shaft 25 feet; vein, 12 feet wide; 25 tons ore on the dump.

Spring Hill and Eldorado Company.—July 3, shaft 47 feet; drift from bottom, northeast, 12 feet.

Southern Slope Tunnel. (*Chloride Tunnel Company.*)—July 3, in 70 feet, through limestone; expected to reach the ledge (which was stripped on the surface) 30 feet further in.

Silver Vault Tunnel.—East side, a little north of the Great Union Tunnel, favorably located and work progressing.

Treasure Hill Mining and Milling Company.—This company owns the Big Smoky mill at Hamilton, and two valuable mines on Treasure Hill, the Nevada and the Summit mines. The two jointly work 65 men by the day, besides doing a good deal on the contract system. Summit has two shafts, 30 feet apart; Nevada two shafts, all in good ore; 40 tons of ore raised and 35 shipped daily. This company also owns the North Iceberg, upon which they are sinking a shaft. June 26, cut on Nevada in 80 feet, leading into an ore chamber 80 feet in length and 30 feet in width, in which breasting was going on in high-grade ore. The end of the cut next to the chamber is 12 feet deep, and the whole mass is ore. Ore yield, 40 tons per day; about the same amount is sent to the mill daily. North Iceberg shaft down 24 feet, and west drift commenced. July 3, still shipping 40 tons per day, and raising about the same. July

ising 30 tons daily. Two shafts down on North Iceberg, connected
e bottom with a drift.

ile Dulce.—Shaft, 34 feet in quartz and spar.

rginia.—One of the foremost mines, on the west side of Treasure
A thousand tons of good ore in sight and on the dumps last June.
statistics of mine promised me by the superintendent, but not re-
d.

tor.—A short distance north of the Horseshoe. June 19, about
ons ore on dump. Shaft, 50 feet, the last 10 feet in good ore.

rd Beecher.—Main street, south end, near the Auroras. June 19,
, 56 feet. June 26, shaft, 60 feet, coming into good ore. July 3,
, 73 feet, drifting.

rd Beecher South.—Adjoining above. June 19, incline, 50 feet.
76, incline, 76 feet; was expected to break into the Earl that night.
3, drifting from 40-foot level toward Napoleon Tunnel.

st Point.—Pogonip Flat. Location 1,000 feet west of and near the
nip and Othello. Ore resembling that of those mines; found in
nels and layers divided by reefs of hard limestone. June 19, had
al cuts and a main shaft 40 feet deep, from which considerable fine
ad been taken. June 26, drifting northwest from the 40-foot level
e main shaft; large amount of fine ore in sight. July 3, north-
west, drift on 40 foot level of the main shaft was in 13 feet. July
rifting east in ore 10 feet from the north end of the surface cut.

bash.—June 26, had some good ore sacked for shipment and a
body in sight in the incline drift to the north.

hite Eagle.—July 3, shaft 35 feet; at 30 feet a drift south-southeast
ed.

is not pretended that the foregoing include all the mines on
ure Hill which are worthy especial mention by reason of their
, amount of work done on them, or general advantages and pros-
, nor that some that will be mentioned afterward, under the gen-
ead of other White Pine mines, are not of more importance than
of those mentioned above. Those given in the foregoing list are
nes on which most work was done during the spring and summer
hs of 1869, and for this reason they are grouped together.

llion Hill.—This is the name of a newly discovered series of ledges
t two miles west of Hamilton, and a short distance south of the old
oad leading down the cañon. It was discovered as early as May,
but was kept quiet until about 200 locations had been made. It has
raised a great excitement, and is not considered second to anything
hite Pine. It has a great advantage over Chloride Flat, as far as
te, wood, and water are concerned, and is generally considered
l to it in the deposit of silver ore, as far as its area goes. The prin-
locations are the Bullion ledges, numbered from 1 to 10 consecu-
, the Sentinel and Bullion Guard, series of equal number. John
t, late owner of the California and West Eberhardt, (which last
d mine he sold in January, 1869, for $85,000,) is the principal owner
e Bullion Hill mines. It is reported that the Chicago hundred who
d White Pine in July last, invested heavily in Bullion Hill.

unt Ophir.—This is the name of a new and very promising mining sec-
which is situated on the western slope of White Pine Mountain, a lit-
uth of west from Shermantown, at a distance, by a rough trail directly
the mountain, of three miles and a half. It is easy of access, how-
by following the road around the southern point of the mountain,
increases the distance to about ten miles from Shermantown.
are 12 mines in the district, upon which the most flattering develop-

ments have been made near the surface, namely, the Little Amador, Cutter, Black Diamond, Nosano, Shiloh, Kern, Locomotive, Atchison & Davis, Margaret, Caroline, Buena Vista, and another, the name of which I failed to note. The Little Amador was the first discovery made in that vicinity, and was located May 5, by a company of Swiss miners, composed of Philip Siebenthaler, J. Forster, D. Teuscher, Joseph Wasescha, P. Reedy, and J. Ott. There are 1,200 feet in the claim, and for about 700 feet the ledge can readily be traced. The ledge at the bottom of the shaft is some 10 feet in width. A rich stratum of pure chloride follows down the entire distance from the surface, increasing from six inches to two feet in thickness. About 40 tons of excellent ore are piled on the dump, which were obtained in sinking the shaft, and without drifting. The first southern extension on the same ledge is the Cutter. This, as in the case of the original location, bears unmistakable evidence of permanence. The ledges show chlorides, but in none of the claims of the new section is base metal to be found. Being on the White Pine Mountain, this may appear strange, but it is nevertheless true. An average of 18 assays from this mine gave $1,730, while others have been obtained yielding a return as high as $3,000 per ton. Further south, on the same ledge, is the Nosano, with a shaft down 15 feet, and carrying well-defined walls and first-class ore. The Black Diamond, Shiloh, Atchison & Davis, and other claims to the southward, also show well for the amount of work performed. About 2,000 feet north of the Little Amador is situated the Buena Vista, also showing a splendid ledge of fine mineral. The mineral belt of the new district appears to be about one-fourth of a mile in width by two to three miles in length.

OTHER MINES ON TREASURE HILL AND IN OTHER PARTS OF THE DISTRICT.

Charles and Theresa.—Chloride Flat, 1,000 feet. Rich strike March 15, 1869. Shaft 20 feet deep at that time. Incline west, 40 feet. Vein at lowest working said to be three feet wide, dipping west 30°. Some rock found assaying $10,000.

St. Lawrence.—Near the cliff mine adjoining Hamilton. Located February 1, 1869. Antimonial sulphurets with ruby silver, furnishing rare and beautiful specimens.

Cliff.—Near Hamilton.

Alexandrine.—East side Treasure Hill, near the Pocotillo.

Norfolk.—Sixteen hundred feet. In Base Metal Range. Galena ore. Assays $400 to $1,000. Some smelted at Swansea, White Pine, gave $430 silver and large amount of lead. Vein, 16 feet wide. Crops 400 feet. Numerous shafts sunk on the croppings.

Golero.—A few hundred feet northeast of Eberhardt, and claimed to be the eastern extension of that famous vein. Up to March 20 not much mineral had been found.

Lookout No. 2.—Located July, 1868, about 1,800 feet north of the Pogonip ground; claimed by the Seymour Company, (Bank of California.)

Silverado.—Located February 25, 1869. 1,000 feet. Is on the east side Treasure Hill, near the summit, in a sag east of Aurora South. No ore and little work.

Cheshire.—Eight hundred feet in claim. 300 feet below the California, on south side of Treasure Hill. Cut, 10 feet deep, 20 feet long. Owners, Robert Cheshire, E. Mattice, C. Dupee, and others.

Idaho.—Located June, 1868. Eight hundred feet. Owners, C. O. Richrdson, and others. On Bromide Flat, about 250 feet north of Empire. March 25, shaft, 8 feet, and drifting east.

Carl and Prussian.—On the point west of Eberhardt, and near the road ading to Silver Springs. Contains copper and lead. Very heavy ore. ssaying $150 in silver.

Cassaday.—Mohawk Cañon, Base Metal range. Galena and chloride, 95 to $238 75, silver. Three feet wide. Traced 300 feet.

Angel.—West base Treasure Hill, south end, near Shermantown and amilton road. Twelve feet wide.

Murray.—Saw-mill Cañon. West slope White Pine Mountain. Four et wide. Fine-looking quartz.

Liberty.—Main street, Treasure City.

Anita.—One and a half mile from Hamilton, on Shermantown road, 0 feet from west side. Base metal and chloride. Assays $200 to 2,000. Supposed to be continuation of the Phœnix. At 10 feet deep 4 feet wide. April 14, 30 tons of ore were on the dump.

Little Monitor.—South side Treasure Hill, near California, and on at belt. Twenty feet wide.

Silver Star.—Near the Virginia. East of Hamilton. Incorporated.

Happy Jack.—East slope Treasure Hill. Two hundred feet from summit. Five feet wide. March 27, incline down 12 feet. Assays from 136 to $900.

Schoharie.—One thousand feet. Located January, 1869. 1,500 feet bove Mazeppa, south side Treasure Hill. Four feet wide. March 27, haft, 15 feet. Chloride and quartz.

Phœnix.—On Rice's toll-road, quarter of a mile from Hamilton. March 7, was taking out several tons of ore daily. Assays from $200 to $500. laimed to be an extension of the Virginia. Shaft, 40 feet, April 25, 869.

Katie.—Near the toll-house, between Treasure and Shermantown. our feet wide. Some specimens assay as high as $1,300.

Featherstone.—Near the Phœnix, and close to Hamilton. Made considerable stir in the early spring. Has been quiet lately.

Black Eagle.—In Spring Mountains, seven miles north of Hamilton. ontains some gold. Pay streak 2 feet wide. Vein, 30 feet. Wood and ater abundant in immediate vicinity.

Buffalo City.—One thousand feet north of American Hotel, Treasure ity. April 16, shaft, 10 feet.

Standing Stone.—Eberhardt City. April 2, good ore taken out, assaying from $300 to $500.

Lady Washington No. 3.—Eberhardt City, base of southern slope Treasure Hill. April 2, good chloride found.

Biggs.—Half a mile from Hamilton; April 9, good ore found.

Willimantic.—Foot of Chloride Flat. Incorporated.

California State Tunnel.—Starts 1,000 feet south of the Eberhardt. Intended to run through West Eberhardt at a depth of 400 feet from the surface of that mine.

Snow Drop.—Chloride Flat, near the road; claimed to be one of the oldest locations and threatens to disturb many now sleeping soundly on their titles. Yielded some very rich ore in early days. Not worked now.

East Eberhardt.—Another location claiming to be on the east extension of the Eberhardt. Owned by a French house in San Francisco, ascal, Dubedat & Co. Charles DeLong, United States minister to apan, has another location on the same ground.

Silver Comet Mining, Milling and Tunnel Company.—Located near the Virginia mine, northwest base of Treasure Hill. Incorporated.

Salt Point Silver Mining Company.—West base Treasure Hill, 600 feet above the road to Shermantown. Incorporated.

La Monte.—Two hundred and fifty feet north of the Eberhardt. Native gold is said to have been found April 1.

Sotoyome.—Twelve hundred feet; located February 24, 1869, on the east side of White Pine Mountain, on the town site of Babylon, by Rogers and others.

Sea Shell.—Four hundred feet south of Sotoyome; located February 24, 1869, by Z. Lyford and others.

Bounding Billow.—East of Main street, Treasure City; south of Hidden Treasure, located March 25, 1869, by Z. Lyford.

Iceberg.—An old and important location on Main street, Treasure City, now included in Aurora. Consolidated.

Gorilla.—West side of Main street, nearly opposite Iceberg.

Storm Cloud.—Chloride Flat, west side of Main street near the street. Rich ore. Litigation ahead.

Oak Hill.—Chloride Flat, near Main street, 600 feet; April 4, down 30 feet.

Derby.—Chloride Flat, near Main street, 800 feet. Very rich ore. Bought by Consolidated Chloride Flat Company.

New Eldorado.—West of but near Main street, Treasure City; located July, 1868; 1,000 feet.

Hyde.—One mile west of Hamilton; 2,000 feet.

Saco.—Sixteen hundred feet southwest of Hamilton, between Phœnix and Hyde.

Bob Allen.—Two and a half miles below Hamilton stage road to Elko; 1,400 feet.

Gregory.—Pogonip Flat, on the side hill below, facing west; 1,200 feet.

Silver Circle.—Fourteen hundred feet, one-quarter mile southeast of Eberhardt.

Letitia and Poole.—Near Blair and Banner State. Incorporated.

Long-looked-for Carson.—Two and a half miles north of Hamilton; contains a remarkable cave.

Crœsus.—Near Hidden Treasure. Worked ore about April 6, at the White Pine mill, in Hamilton, which gave $257 per ton.

Stewart.—(See Mahogany in first list.)

Buckland.—Near Keystone and Eberhardt, Treasure Hill.

O'Keefe.—On Blue Hill, west of Hamilton, near Phœnix; April 4, shaft 8 feet deep, with a good pile of ore on the dump.

Oriole.—Near O'Keefe.

Foy & Haggerty.—Three-quarters of a mile northeast of Hamilton. Ledge stripped 100 feet; at one place 3 feet wide. Assay $444 52, $580, $2,250.

Saginaw.—Six hundred feet south of Hidden Treasure.

Orphan Boy.—Near Mazeppa; legal difficulties. Work stopped April 7, 1869.

Black Cloud.—Southern slope of Treasure Hill, a little south of the Eberhardt. Had good ore April 7; in several shafts from 5 to 18 feet deep. North wall stands nearly vertical; south wall not found at that date; 15 or 20 tons of ore had been taken from the principal opening, which was about 15 feet deep. Assays $200 to $1,500. Located January 19, 1869.

Monster.—South side Treasure Hill, a little above Eberhardt City, at e town of Menken.

Bromide Tunnel Company.—On Bromide Flat. Incorporated.

Mayflower Mining Company.—On the road from Hamilton to Treasure ity, nearest to Hamilton.

Kohler Mining Company.—April 8, was erecting a mill at Pleasant Val- y 1½ mile south of Shermantown.

Umatilla.—Lower end of Bromide Flat. Fine ore.

Ocha Vera.—In a cañon southeast of Hamilton, near the town. Lo- ted April 8, 1869; crops 600 feet, 7½ feet wide. Assays $1,300, and ntains some copper.

Peninsula.—Six hundred feet east of south of Hidden Treasure on reasure Hill; near a ridge of rocks overlooking the cañon east.

Hidden Treasure No. 2.—Located March, 1868; in the rear of Pacific nion Express office.

Shamrock No. 3.—About 200 yards below Arcade on Silver Glance, bout one mile east of Eberhardt; 1,000 feet in the claim. Located by unn & Leonard, January 28, 1869.

Illinois No. 10.—Sixteen hundred feet. Is about 800 feet from Buffalo ity mine, about 1,000 feet west of Union street, at the base of the west lope of Treasure Hill.

Leonard.—Across the cañon directly west from the Illinois in Base etal range about 2,000 feet from Illinois. Eight hundred feet in claim.

Umatilla.—Twelve hundred feet. Lies north of Mazeppa half a mile, n south slope of Treasure Hill. Croppings light. Country rock, lime- tone and spar. Course nearly north and south.

Mutual.—Bromide Flat. West of Hallock and Meyers's store.

Limestone.—Considerably below the Mutual on the road.

Cuckoo.—Near Swansea on the road from Hamilton to Sherman. ows some very good ore with galena.

Zaphna.—M. J. Henlay, Elias, and others, owners. About one- hth of a mile below Swansea, on the left of the road, thence to Sher- n in a cañon leading down to the road, about 200 yards up that on, on the right. Very promising ledge. Price demanded May 18, 9, $10,000.

Belisarius.—On top of hill, half a mile northeast of Shermantown.

Bunker Hill.—Forty feet east of Belisarius. Does not show much.

Some Pumpkins.—Near Belisarius, and within sight of Shermantown. urse distinctly marked east and west. Dips north 70°. Two to five t wide. Looked well May 18, 1869. Shows fine mineral advantage- sly situated for working. Held at $12,000.

Grape Vine.—A little north of last. Showing favorably.

Winning Hand.—A little south of Grape Vine. A cut run across and ng the vein shows some ore.

Industry.—North of last across a cañon.

Spitzbergen.—East of Industry about 100 feet.

Juggernaut.—A few hundred feet west of Industry.

Eva Jane.—Up the cañon some distance, east of Industry and north of ra Jones. Shows splendid mineral.

Cremorne.—Chester Company, a few hundred yards west of the toll- use, on the road from Hamilton to Shermantown; in the Base Metal ge. Gangue, spar and quartz; ore, chloride and horn-silver, small ount of lead. Through the body of the vein matter, the width of ich has not been ascertained, there is a streak of rich ore two feet le, which assays $250 to $1,100. Fissure nearly vertical. Strike t and west shows several hundred feet on the surface.

Arco Iris.—Not far from Cremorne. Ores, chlorides and sulphurets of silver. Heavy body of spar for hanging wall, stringers of which permeate the lode in every direction. Assays $500; $800 for the better class; great quantities from $100 to $200.

Diana.—North of Arco Iris, which it greatly resembles. Vein 12 feet wide. Crops 600 feet. $250 to $700.

Bright.—One thousand feet. Located October 28, 1868. Owned by A. D. McCulloch and others. Situated a quarter of a mile east of Eberhardt, below the line of Eberhardt. 15 feet wide. About $600 worth of work done in open cut.

Burns.—Chloride Flat. Ore at 30 feet depth.

Mountain Boy and Silver Queen.—On "Take-a-nip Flat." Sixteen hundred feet. Two parallel ledges. Shaft between them, 40 feet deep. Yields good ore.

Trench.—Located March 29, 1869, by Captain Layne, of the Hidden Treasure. In Base Metal range, 6 feet wide.

Latest Discovery.—Near the Trench, above noted.

Westford.—On Blue Hill, directly northeast of Hamilton. Twelve hundred feet in extent. Good ore; assays $125 to $1,000.

Bowers.—About 400 yards from the Westford on the western slope of the hill. Located April, 1869. Ten feet wide. Estimated to go $200 per ton.

Idlewild.—A few hundred feet below the Bowers. Located April, 1869. Ore resembles that of Chloride Flat. Veins easily traced 2,000 feet, with an apparent width of 30 feet.

Three Kings.—In the bend of the Sheehan toll-road, northern slope of Treasure Hill.

Alturas.—Surrendered its title to the Post-hole latter part of June.

Borealis.—Main street, above Stony Point, Treasure City.

Hamilton Tunnel and Hydraulic Mining Company.—Organized for mining and milling purposes. Has a location of a quarter section of land, about one mile east of Hamilton, with a spring on it. The intention of the company is declared to be to run a tunnel from the west base of Treasure Hill to a point directly under the summit, 3,400 feet from their starting point.

Dawson.—South of Hamiltown, near Rice's toll-road.

El Dorado.—On a hill of the same name, at the north end of Treasure City. Located May, 1869, by John A. Steele. A considerable quantity of ore has been extracted.

Cadiz.—Base Metal range, two miles west of Shermantown, 5 feet wide. Carbonate of lead and some silver; assayed $78 54 silver and 65 per cent. lead.

Michael O'Nasby.—Pocotillo Flat. Shaft, 34 feet; ledge, 3 feet wide, smooth walls; vein matter, spar and quartz.

Mohawk No 10.—Four miles northwest of Hamilton. H. C. Jack[illegible] discoverer. Selected specimens assay $700 to $3,411 37, by roast[illegible] specimens coated with silver.

Inland Empire.—Extension of Mohawk No. 10. Located by Pat. H[illegible]land. Assays, $723 60.

Elian Cave and Mining Company.—Two miles west of Hamilton.

Elms.—First extension south of Anita Cutter, six miles west of S[illegible]mantown, at the foot of White Pine range, 6 feet wide. Assays from $31 42 to $4,583 24.

Little Phil. Sheridan.—A few hundred feet south of Pocotillo. S[illegible] good ore on the dump June 16, 1869.

it.—South side Treasure Hill, between Eberhardt and Mazeppa.
re at 12 feet depth.

rood Tunnel Company.—East side Treasure Hill, 1,400 feet below
lo.

nond.—A location on the southeast corner of the Eberhardt, that
jury said it was on the Eberhardt, but the owners still hope to
hat it is not.

ucky Home No. 3.—One mile south of Hamilton in Base Metal
Assays $570. 100 tons on the dump in the spring.

ace.—Three quarters of a mile east of Eberhardt. Owned by a
ıy composed exclusively of printers. They own also the Nonpa-
l Turrel.

wood.—At the head of old Hendrie Mill cañon, on the west side
Metal range. Five feet wide.

r's Delight.—Near Greenwood.

rprise.—Near Greenwood.

eman and Loneman.—Just over, the peak from Aurora Consoli-
Treasure Hill. June 29, shaft, 78 feet.

adillo.—Incorporated. Capital stock $2,400,000. Running for
edges in Treasure Hill.

.—Near the trail from Treasure City to Shermantown. Located
1, 1869. Assays, $414 40.

t.—Another location on the Todd.

notive.—Also on the Todd. It is thought the Locomotive will
o the Depot if the company keep up steam long enough.

lvor.—North side of Bromide Flat. Shaft, 50 feet, June 30.

inia Tunnel Company.—Pogonip flat. Running for blind ledges.

e Lamar.—On the ridge leading southeast from the Eberhardt.
ıe brow of the cliff below the Poor Man..

List of White Pine incorporations, formed mostly in San Francisco.

Name.	Incorporated.	Shares.	Capital.
nsolidated	Dec. 11	16,000	$1,600,000
Milling, Mining and Tunnel Company	Feb. 18	40,000	4,000,000
	Feb. 19	13,000	1,300,000
	Mar. 6	4,000	400,000
	Mar. 9	10,000	1,000,000
nnel and Mining	Mar. 15	14,400	1,440,000
	Mar. 21	12,000	1,200,000
	Mar. 23	20,000	1,000,000
	Mar 23	12,000	1,200,000
	April 18	10,000	1,000,000
	April 23	....	2,400,000
	Dec. 2	10,000	1,000,000
	Jan. 19	2,000	200,000
	Jan. 29	10,000	500,000
te	Feb. 18	10,000	1,000,000
	Feb. 26	10,000	1,000,000
unnel	Feb. 27	30,000	3,000,000
	Feb. 27	16,000	800,000
	Feb. 27	5,000	1,000,000
lat	Mar. 2	50,000	5,000,000
k	Mar. 3	5,000	500,000
et	Mar. 3	5,000	1,500,000
Franklin	Mar. 5	12,000	1,200,000
nond	Mar. 6	4,000	400,000
	Mar. 16	6,000	600,000
	Mar. 31	....	1,400,000
White Pine	Dec. 17	15,000	1,500,000
ed Chloride Flat	Dec. 23	50,000	5,000,000
lat and Aurora Tunnel	Dec. 26	10,000	1,000,000
d	Dec. 26	10,000	5,000,000
nief	Jan. 27	12,000	1,200,000
	Jan. 29	15,000	1,500,000
lountain and Tunnel	Feb. 1	5,000	500,000
Gold and Silver	Feb. 8	4,800	480,000
lat Lode and Tunnel	Feb. 17	10,000	1,000,000

List of White Pine incorporations, &c.—**Continued.**

Name.	Incorporated.	Shares.
Crown Lode and Tunnel		10,000
Cliff Lode and Tunnel	Feb. 18	10,000
Cortez	Feb. 22	24,000
Capital	Mar. 2	6,000
Chloride Range Consolidated and Tunnel	Mar. 5	50,000
Chicago Mining	Mar. 8	20,000
Carrington	Mar. 14	12,000
Charles Sumner	Mar. 16	6,000
Consolidated Eberhardt	Dec. 1	10,000
Chloride Flat	April 26	25,000
Chester Company	April 29	
Douglass	Jan. 11	3,200
Diamond Silver	Jan. 15	14,000
Dolomite Consolidated	Jan. 21	5,000
Dinero	Feb. 10	7,500
Dundee	Feb. 18	10,000
Daniel Webster	Feb. 24	12,000
Day Star	Mar. 4	16,000
Dave Williamson Tunnel and Mining	Mar. 22	8,000
Dora and Chauncey Consolidated	Mar. 9	12,000
Eclipse Chloride Flat	Feb. 3	50,000
Eastern Slope Tunnel and Mining	Feb. 7	10,000
Etna	Feb. 18	10,000
Edith	Feb. 18	10,000
Egleston & Brown	Mar. 5	10,000
Eberhardt Mill and Mining	Mar. 6	120,000
Estelle No. 2	Mar. 23	12,000
Eureka	Mar. 25	10,000
Empire	Mar. 14	8,000
Europe	Mar. 30	20,000
Eastern Enterprise	April 9	10,000
Evening Star	April 10	18,000
Enoch Arden	April 10	10,000
Emanuel	April 18	10,000
Five-Forty	Feb. 25	12,000
Featherstone	Jan. 26	14,000
Florence Mining and Tunnel	Mar. 24	10,000
French	Mar. 30	14,000
Grand Trunk Tunnel		
George Washington	April 23	
Green Mountain	April 18	14,000
Georgia	Mar. 3	14,400
Germania Consolidated	Mar. 18	20,000
Grant Invincible	Mar. 21	8,000
Great Republic	Mar. 25	10,000
Golconda	Jan. 25	8,000
Great Union Mining and Tunnel	Mar. 11	60,000
Hidden Treasure Consolidated	Mar. 21	12,000
Hornet	Mar. 26	10,000
Hearst Mining	Mar. 8	30,000
Holcombe	Jan. 25	8,000
Ida	Jan. 28	3,200
Ion	Feb. 13	14,000
Independence Consolidated	Mar. 18	20,000
Imperial	Mar. 25	10,000
Kewanee	Feb. 16	8,000
Knox Tunnel and Mining	Feb. 2	4,000
Letitia and Poole Consolidated	Feb. 17	14,000
Little River	Feb. 27	5,000
Louisiana	Feb. 27	20,000
La Belle	Mar. 24	25,000
Lucky Ledge	Mar. 18	20,000
Latowana	Mar. 18	19,200
Lexington Mill and Mining	Jan. 29	16,000
Larcombe		1,400
Lee	April 9	10,000
Ludlow	April 18	12,000
Marlborough		10,000
Madden	April 10	40,000
Monte Christo	Dec. 4	14,000
Maid of Saragossa	Dec. 31	20,000
Monroe	Jan. 11	10,000
Metropolitan Milling and Mining	Jan. 17	10,000
Miantonomah	Feb. 5	4,800
Magenta	Feb. 8	14,000
Marion	Feb. 11	10,400
Mammoth	Feb. 16	36,000
Main Street	Mar. 3	5,000
May Wentworth	Mar. 18	10,000
Mount Moriah	Mar. 21	6,000
Mazeppa	Mar. 9	8,000
Mocking Bird	Mar. 5	14,000

List of White Pine incorporations, &c.—Continued.

Name.	Incorporated.	Shares.	Capital.
	Jan. 24	20,000	$2,000,000
old and Silver	Mar. 8	10,000	1,000,000
	Mar. 16	20,000	1,000,000
	Mar. 17	12,000	1,200,000
rica	Mar. 14	12,000	1,200,000
dden Treasure	Feb. 2	16,000	1,600,000
	Feb. 12	8,000	800,000
	Mar. 1	7,200	720,000
ampion Mining and Tunnel	Mar. 6	15,000	1,500,000
rth	Mar. 14	6,000	600,000
	Mar. 14	10,000	1,000,000
	Dec. 21	4,000	800,000
	Jan. 25	1,000	100,000
	Jan. 28	4,000	400,000
an	Feb. 4	10,000	1,000,000
at Consolidated	Feb. 5	12,000	1,200,000
ia Tunnel and Mining	Feb. 13	10,000	1,000,000
solidated	Feb. 20	20,000	2,000,000
	Feb. 27	16,000	800,000
ft	Mar. 5	10,000	1,000,000
hovel	Mar. 11	16,000	1,600,000
	Mar. 14	12,000	1,200,000
a Brewery	Mar. 15	18,000	1,800,000
	Mar. 15	24,000	2,400,000
West	Mar. 25	10,000	1,000 000
d Dixon	April 29	....	500,000
d Silver Gate	Mar. 30	4,000	400,000
	Feb. 16	8,000	800,000
	Mar. 12	10,000	1,000,000
	Mar. 4	16,000	1,600,000
	Mar. 29	44,000	4,400,000
	Jan. 15	200	18,000
nia	Jan. 22	16,000	1,600,000
co and White Pine	Jan. 29	6,000	600,000
	Feb. 1	12,000	1,200,000
co and Treasure City	Feb. 1	20,000	1,000,000
ra	Feb. 3	24,000	2,400,000
ace	Feb. 25	10,000	1,000,000
	Feb. 26	10,000	1,000,000
t Milling, Mining, and Tunnel	Mar. 2	16,000	1,600,000
et	Mar. 3	5,000	1,500,000
	Feb. 27	16,000	800,000
	Mar. 6	8,000	800,000
s	Mar. 9	8,000	800,000
Consolidated	Mar. 11	5,200	520,000
	Mar. 14	11,000	1,100,000
hardt Tunnel and Mining	Mar. 15	14,400	1,440,000
s	Mar. 23	20,000	2,000,000
Boring and Mining	Mar. 24	6,000	600,000
Silver Ledge	Mar. 24	1,400	140,000
n	Mar. 25	10,000	1,000,000
	Mar. 25	10,000	1,000,000
	Mar. 29	10,000	5,000,000
	Jan. 12	12,000	1,200,000
	Jan. 25	1,000	100,000
ove Consolidated	Jan. 27	5,250	525,000
	Feb. 16	12,000	1,200,000
	Feb. 18	7,500	750,000
ll Consolidated	Feb. 24	50,000	5,000,000
ll Tunnel	Feb. 25	20,000	2,000,000
s	Feb. 27	5,000	1,500,000
	Mar. 3	12,000	1,200,000
x	Mar. 8	20,000	2,000,000
ak Consolidated	Mar. 22	14,000	720,000
	April 12	8,000	800,000
in	April 29	....	1,000,000
	Dec. 1	16,000	1,600,000
. 2	Jan. 19	8,000	800,000
	April 26	12,000	1,200,000
nia	Mar. 31	....	1,600,000
	April 13	14,000	1,400,000
Smelting	Jan. 19	5,000	50,000
Mutual Milling	Jan. 19	10,000	1,000,000
	Feb. 5	10,000	1,000,000
	Feb. 24	4,000	1,000,000
Associates	Mar. 8	11	11,000
	Mar. 14	5,000	2,500,000
rdt Tunnel and Mining	Mar. 15	12,000	1,200,000
f nominal capital	....	....	277,564,000

MILLS.

In the month of May, 1869, there were, running or building, the following mills in White Pine:

Shermantown.—Eberhardt Company, 2 mills, 10 and 8 stamps; Metropolitan Company, 15 stamps; Kohlers & Co., 8 stamps, (rotary battery;) Moyles, 5 stamps; Union Mill Company, 15 stamps.

Hamilton.—White Pine Milling and Mining Company, 10 stamps; Treasure Mining Company, 5 stamps; Old Big Smoky mill, 20 stamps; Dayton mill, 10 stamps; Henderson's mill, 2 stamps; mill one and a half mile east of Hamilton, 10 stamps; Centenary mill, Newark, twenty-eight miles distant, 20 stamps.

Total, 12 mills, with 113 stamps, or, counting the Centenary, 13 mills, with 133 stamps. These mills were all running before July, and many others have been erected since. The number in August was 13 mills, with 135 stamps. To these were added, a little later, the Stanford, (30 stamps,) at Eberhardt City, about two miles from Treasure Hill and the same distance from Shermantown, and one or two more, so that White Pine probably possesses, January, 1870, an effective force of 200 stamps.

SMELTING.

Considerable attention has been paid to this system of reduction, there being an immense amount of ore in the Base range which can be utilized by no other process. Two very large and expensive furnaces have been built, but up to July they were not in regular operation. According to the News, the smelting works owned by Mr. J. J. Bassey, near Swansea, had just made a second run, May 9, 1869, on ore from the Base Metal range. Three and a half tons were reduced, yielding 2,400 pounds of metal, or about 600 pounds to the ton—assay value, $227 40. The ledge from which this ore was obtained was said to be about 150 feet wide.

COAL-FIELDS IN WHITE PINE.

In a country where so much fuel is already used, and likely to be necessary for a long time to come, and where the growth of timber is so limited, as in White Pine, it is natural that much stress should have been laid on the discovery of coal. Bituminous shales being a prominent constituent of the formation east of Hamilton, many have expected to find coal in this neighborhood, and small seams of an inferior lignite have actually been found on the quarter section owned by W. G. Sanderson. But the beds found so far will never be of the slightest consequence as far as practical use of the coal is concerned, not alone on account of their small extent, but also because the quality of the fuel is entirely unsatisfactory.

WATER.

The want of nothing has been felt so much by the inhabitants of Treasure City and the milling interests of the neighborhoods as that of an abundant and cheap supply of water. At last a corporation—the White Pine Water Company—took hold of the enterprise, to supply not alone Treasure City, but also Hamilton, Shermantown, Eberhardt, and the mills erected at present and those to be built in the future, with such quantities of water as may become necessary for consumption in the different ways that liquid is used in a mining region.

The company was organized in San Francisco with a capital of

,000,000, divided into shares of $1,000 each. The corporate duration the organization was limited to fifty years. Colonel A. W. Von hmidt, A. P. Stanford, W. C. Ralston, Alvinza Hayward, and other ually wealthy and substantial residents of the Bay City, were among e trustees of the company. Colonel A. W. Von Schmidt was the enieer and projector of the enterprise.

The water of Illapah (Clear Water) Creek, a stream which has its origin a large spring about three miles from Hamilton, on the other side of e Momomoke Mountain, was selected to furnish the contemplated supr. The spring discharges about 300 miners' inches of water. It flows rth for about 10 miles and disappears at that point under a mountain. e water has been caught in a reservoir a few rods below the spring. re the first engine of 150 horse-power is located, which raises the ter 438 feet up the side of the mountain into a reservoir, from which is forced a second 438 feet up to the mouth of the tunnel, which, 60 t below the crest of the mountains, has been driven by the company rough to the Hamilton side. At the mouth of this tunnel is a large ervoir, containing 220,000 gallons of water, which is to be used for usual contingencies. Twelve-inch water pipes are laid throughout up this point. From here part of the water is conducted to a reservoir e-half mile distant, which has a capacity of 1,000,000 gallons and is uated 160 feet above the corner of Main and Hamilton streets, so that ample fall is secured to supply any part of Hamilton City. Another rt of the water is conducted through pipes down the mountain and Treasure Hill into another reservoir of the same capacity as the foreing, to a point in the neighborhood of the original Hidden Treasure, ich is to supply Treasure City. The work is said to have cost 00,000, and was expected to confer an incalculable benefit on this ining region.*

BUILDING MATERIAL.

Although a great deal of timber well fitted for sawing into lumber ists on the White Pine Mountain range, and though several sawmills ve tried their best to supply the demand, lumber has been sold mostly the high rates of $300 to $350 per thousand feet. The excessive dend during the excited times of the past, and the difficulty of hauling, ve been the main causes of these exorbitant prices, and it is confintly expected that lumber for building purposes will be bought in inary times at less than one-fourth of the above figures. For the lding of more substantial structures the country furnishes an excelt limestone and an easily-worked rock, occurring near Shermantown, ich hardens on exposure to the air. Clay for the manufacture of ck is also abundant in most of the valleys.

EGAN CAÑON.

he following interesting description of the mines of Egan Cañon, an mining district, was prepared by Mr. L. F. Emmons, connected with g's geological expedition. The district is in the northeastern part White Pine County, about one hundred miles distant from Treasure y:

> here the overland road crosses the Egan Mountains, they are divided into two es, between which lies a pretty mountain valley, surrounded by well-wooded hills, of access, and in the valley bottom are good grass and plentiful springs.

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* The triumph of engineering skill in the construction of the works is unquestion- , but the receipts of the company have not been sufficient to insure its prosperity; it is now reported that the works have recently (March, 1870) been sold at auction.

The water from this valley finds an outlet in a northerly and easterly direc through Egan Cañon, at the head of which is situated the town and a 5-stamp The western ledge is composed of limestone, the eastern of metamorphic rock, pri pally of quartzite, the formation having a north and south direction (magnetic,) dipping to the westward. At the mouth of Egan Cañon, on Steptoe Valley, gra comes up, extending on the north along the lower foot-hills, and on the south furt or rather higher up, into the range. Above the granite are quartzite cliffs, exten nearly up to the town, (the cañon is about one and a half or two miles long,) wl the quartzite alternates with chlorite schist. At the mill, in the upper part of town, is a stratum of fine roofing slate. In the lower hill, north of the town, al 300 feet above it, are the croppings of the Gilligan ledge, which runs northeast southwest, and dips from 60 degrees to 70 degrees to the northwest. This l belongs to the Social and Steptoe Mining Company of New York.

This company was incorporated in September, 1861, formed by the consolidatio the Social Company, owning the Gilligan ledge and a 5-stamp mill, and the Ste Company, owning extensions on the Gilligan as well as several other ledges, a 10-stamp mill, of which the frame is now standing at the lower end of the ca while the machinery is stored at Salt Lake City. From 1866 to March, 1868, 5-stamp mill has been running on ore from the Gilligan ledge, with sufficient prof pay general expenses, and the developing of the mine.

The mill has five stamps, weighing about 650 pounds each, which stamp dry, pulverized ore being carried from the battery to the dust-chamber, which is above a fan-blower, thereby saving much dust; three Varney pans and two settlers, wl give a capacity of about five tons per twenty-four hours. The motive power is a 8-inch cylinder, horizontal-working steam-engine, which works the stamps, pans, tlers, and blowers, (250 revolutions.) It is also used to run a circular saw, which the company saw all their mining and building timbers, fir and yellow p that they cut in the neighboring hills. Wood, as fuel, costs at the mill $3 50 cord.

The mine is opened by three shafts or inclines; the principal is worked by a ho whim. This shaft was originally sunk in the ledge, (which dips from 60 degrees t degrees,) and consequently, with a varying inclination, 400 feet below the surface; water coming in at the bottom in large quantities, the lower works were abando the 300-foot level is now the lowest worked. From this depth up to within som feet of the surface the incline has been enlarged and straightened, new timbers pu and a ceiling of 2-inch stuff throughout the greater part of its extent. This work been progressing since the stoppage of the mill. Near the surface a body of ore been stoped out to the northeast of the shaft, which yielded in the mill $18 averaging $200 per ton. From this point down to the 300-foot level, no ore has b taken out except in sinking, but the vein is said to have maintained the same cha ter throughout. On the 300-foot level drifts have been run 150 feet southwest, 120 feet northeast. In the former the vein is very regular, being a broken qu somewhat decomposed, colored with iron oxide, and showing some sulphurets of sil It has a width of from four and one-half to six feet, so that the entire drift is in vein, the hanging wall being remarkably clean and distinct, having a clay goug decomposed slate. The foot-wall is not so distinct; the country rock seems to be pregnated with quartz and vein matter some distance from the vein. The vein h small seam running through the middle, dividing it into two characters or class ore. The second or poorer class, which comes on the foot-wall, has hitherto been carded for want of hoisting power, and used to fill up deserted works, *e. g.*, the incl below the 300-foot level is mostly filled up with this ore. Mr. O'Dougherty, the sup intendent, assures me that the whole vein without assorting will run $50 per to the mill; that the richer ore often runs from $100 to $200, and a black clayey which occurs, sill richer.

To the northwest the vein maintains the same character, but within 20 feet of present face it pinches to two or three feet, the quartz becoming whiter, more comp and less rich, resuming its former character, however, at the face. Take it altoget this vein shows a remarkable regularity throughout. At 50 feet from the face a st has been run up some 15 feet from the floor of the level, nearly to the face of the d which has been filled in with second-class ore taken from this drift. On the surf to the southwest of the shaft, the vein has been stripped to a distance of 500 feet, p ing a change in the formation from quartzite to chlorite schist. It shows a unif width of quartz of good appearance throughout, and is said to yield very well in g toward the extremity. Three hundred feet to the northeast of the main shaft, anot shaft has been sunk in a sort of ravine or bend in the slope of the hill, to a depth 120 feet, said to be in good ore, and here about eight feet wide. The quartz in dump has a whiter, more compact appearance than that taken from the other sh It is intended to extend the drift on the 300-foot level to connect with this shaft, wh will then be used as an air shaft.

Eight hundred feet have thus been traced on the original ledge. The original le

;ives the company 1,600 feet, and extensions (1,600 feet, and 800 feet northwest) their claim 4,000 feet long. About midway between the two shafts another has sunk to the depth of 75 feet, said to yield good ore. From what I have seen, and ding to Mr. Dougherty, whom I have every reason to believe, the mine seems to ie of great promise, having a very large body of ore in sight, which is easily ed, and yields a fair profit. I should judge they must have some 20,000 tons of ore ht, estimating the vein to be nearly as uniform above as in the 300-foot level, say eet thick and 200 feet in length. It is the intention of the company to erect a amp wet crushing mill, with which they calculate to extract seventy per cent. of ullion, to treat the ore for $12, and have an average yield from the whole vein of er ton. For this it will be necessary for them to put up a new shaft-house, and steam-hoisting machinery. The ore for the past few months has yielded bullion ine, being gold and silver in the proportion of 86 cents gold and $1 20 silver to unce, the ounce being worth $2 06.

. O'Dougherty assures me that the mine has paid its way since the commencement gh the profit on ore extracted from the shafts, drifts, and their few stopes, and ed in their 5-stamp mill. Since the stoppage of their mill they have been incurexpenses without any corresponding income to the amount of $12,000.

low the town two men are running a small arrastra by water-power furnished by tream running out of the valley. They are crushing a gold-bearing quartz from ge higher up on the hills north of the mouth of the cañon, called the Gold Cañon . It is a clear white quartz, showing occasional specks of native gold. They about five hundred pounds per diem, which yields them at present at the rate of $50 per ton. They have sufficient power to run stamps if they had them. As they break up the ore by hand to the size of a filbert.

EUREKA DISTRICT.

ie mines of Eureka were discovered and the district organized ly five years ago, but as the ores are largely composed of base ils, their development has been neglected. The district is situated it forty miles west of White Pine, in what is known as the Diamond ge. The deposits are frequently large, but occur irregularly in stone. They contain smelting ores, which, for cheap reduction, it to be dressed before they reach the furnaces.

ie principal deposits are the Juno, Inca, Ruby, Summit, Sunburst, ka, Giant, Grant, Tiger, Lily, and Gem, all of them situate on ral and Silver Hills. A shaft furnace has been built in the neighood of these mines during the last year, by Mr. C. A. Stetefeldt, ng engineer, in which he has smelted some of the ore taken from al of the above mines. The principal difficulty encountered was arge proportion of gangue delivered with the ores at the furnace, at enormous quantities of flux had to be added to make smelting ble, and pecuniary embarrassments of the company prevented even ompletion of the works.

e ores of the district assay well, an average of many, made of the ting ores by Mr. Stetefeldt, yielding as high as $80 per ton in sil- Besides its ores the district contains an abundance of wood, water, building-stone.

ie latest discoveries in Secret Ravine contain rich ores resembling e from White Pine. The average value of the ores of this new ict probably surpasses that of the ores from the base range at White

GRANT, TROY, AND SEYMOUR DISTRICTS.

hese three districts lie nearly due south of Hamilton, and about ty miles distant. From the mountain (White Pine belt) spurs nged in a half-moon or circle run out into this region. Grant lies the north of the arc, and Troy on the south, while the Irwin Cañon ymour district) makes down from the extreme summit of the mountain to the valley below. In other words, it is the central point between Grant and Troy.

A large mineral belt, commencing at the Grant Cañon, runs south, through Seymour, Troy, and a long distance below. The country rock is slate and granite, and in this are found a number of large veins, the croppings of which can easily be traced on the surface. They contain pure silver ores, and some base metal ores. The Chieftain, Mountain Chief, La Grange, Black Warrior, Catarina, Eureka, and Black Prince, are the principal veins in Seymour; the Blue Eagle lode is the most noted lode in Troy. Timber for use as lumber and firewood, water, and grass, are abundant. Salt in great quantity occurs in the McDonald and the Butterfield salt-beds in the valley in front of Seymour district.

KERN DISTRICT.

Kern district is situate about twenty-five miles east of Egan cañon, on the eastern slope of Shell Creek range, and ninety miles distant from Hamilton. It is only ten miles south of the Antelope station on the Overland road, and within twenty miles of the Utah line. The country rock is granite. Some twenty-five ledges have been discovered in it, all of which run northeast and southwest, are very regular in their course, and vary in thickness from eighteen inches to eight feet. They dip from fifty to seventy degrees to the east, and carry mostly sulphurets of silver in a quartzose gangue, with some decomposed ores at the surface. Assays of specimens brought to Hamilton yielded from $200 to $900 per ton, and 22 pounds of rock worked in a pan yielded $560 to the ton. The district promises to be quite an important one.

PATTERSON DISTRICT.

Patterson district is situate on the eastern range of the Buckskin or White Mountains, eighty-five miles southeast of Hamilton and in a lower altitude than that town. A survey will be necessary to determine whether it is in White Pine or Nye County. Two town sites, Montezuma and Springville, are laid out in the district, the first in the immediate vicinity of the mines, the other one and a half mile distant in a valley. The mines were first discovered in the mountain pass between Cave and Steptoe valleys, a locality where wood is abundant, but large timber rather scarce. About two hundred and fifty claims have been located, all in a limestone formation and carrying ores very similar to those of Treasure Hill. The Great Eastern, according to the croppings and assays made of its ores, appears to be the most important of all at the present time. The Emigrant, San José, San Francisco, Oakland, Rough and Ready, Atlantic Cable, Ida Elmore, Blue Jay, and Clay are also thought very valuable. A large lot of ore from the Great Eastern, which was worked by mill process, yielded $268 per ton, and a great deal of that class is said to be in sight. A large cave, which has been explored for a mile and a half in length, and which seems to have been the passage of a subterranean river, to judge from the pebbles on the floor, has been found in a spur running out from the mountain on which the mines are located. Its end has not been reached as yet.

Water is comparatively plenty in the district, at least it is so at Springville, one and a half mile from the mines. Large groves of splendid yellow pine for building purposes exist seven and twelve miles west of the mines. The district is only sixty miles from the Mormon settlements of Meadow Valley, and provisions are therefore much-cheaper than at White Pine. Considerable excitement has been caused by the late discovery of these mines, but they are rather too new to permit of a special description.

PIUTE DISTRICT.

This is a new district situate forty miles west of Hamilton, a short distance from the road leading from that place to Austin. The C. L. Place, New York, Last Chance, San Francisco, and Our Own No. 1, are the principal locations made. The ore assayed so far, yielded from $123 to $600 per ton.

ROBINSON DISTRICT.

Robinson's ranch, where the new town, Mineral City, is located, is situate thirty-five miles due east of Hamilton, five miles north of the southern, and forty miles west of the eastern boundary line of White Pine County, and forty-five miles north of Patterson, in a lovely valley bordering on Murray Creek, three miles from Steptoe Valley. The mines of the district so far discovered are located along the ridges on both sides of the valley, up to the main range of mountains. They contain principally lead ores and antimonial ores of silver, the former predominating. The Robinson, City of London, and Old England are the principal veins at present. The City of London is reported to be over one hundred feet wide and the croppings protrude fifteen feet above the surface of the ridge, dividing the upper end of Robinson Valley on which it is located. The bulk of the ores in this district will have to be treated by smelting. The country is well provided with water and enjoys an abundance of timber for building and smelting purposes.

SACRAMENTO DISTRICT.

Sacramento District is a new mining district organized in Spring Valley, in the foot-hills of the Snake Mountains, ninety miles in a north-easterly direction from White Pine, on the old Simpson trail. The ledges occur in limestone and slate and carry gold and silver.

SAN FRANCISCO DISTRICT.

San Francisco District is located at the Hercules Gate, fifty-five miles from Hamilton by the road, but in a straight line not more than forty. The silver ores occur in a limestone formation similar to that of Treasure Hill. None of the claims are sufficiently developed to admit of description.

PINTO DISTRICT.

Pinto district is situate about twenty-eight miles west of Hamilton by the old Austin road, but the new road through Independent Cañon reduces the distance to twenty miles. Silverado, the principal town of the district, lies four and one-half miles southwest of the Pinto Creek station on the Austin road. The country rock is limestone, slate, and granite. The Cole & Johnson is the principal mine in the district. It is a very wide ledge, which carries chlorides, sulphurets, and some ruby silver. A shaft has been sunk on it to a depth of 65 feet. The Our Own No. 1, Our Own No. 2, Du Quette, Virginia, Medford, Pyramid, Wisconsin, and Fortuna, are claims which give fair promise of great value according to the assays of the surface ores. Water is four miles distant from the town; wood is present in sufficient quantity.

SNAKE AND SHOSHONE DISTRICTS.

Shoshone district is situate twenty-five miles northeast from Patterson. The mines are located on the western slope of the White Mountain, a lofty peak of the Snake range, which is covered with perpetual snow. The ledges are mostly large and carry chlorides assaying very high, (from $600 to $800 per ton.) Twenty-five miles north of Shoshone is the Snake Mountain district on the eastern slope of that range. The district is well wooded and watered. The mines carry rich sulphurets of silver and are distant sixty-five miles from Fillmore City, Utah, where provisions can be bought cheap.

PANCAKE DISTRICT.

Pancake district was organized in April of this year on Pancake Mountain, fifteen miles southwest of Hamilton, and one and a half mile from the Elko road. The ores found here carry chlorides and are similar in character to those of White Pine. The main ledge crops out for three miles, and the croppings assay $80 per ton.

WAGON ROUTES, STAGING, COST OF TRAVEL, ETC.

White Pine County is beginning to be provided with good roads to connect it with the outside world. Besides the graded roads in the immediate vicinity of the mines, a road is being built from Carlin, a station on the railroad, to Hamilton. This road will be eighteen miles shorter than that from Elko, and travelers from Sacramento will save forty miles by taking that route to White Pine. It is intended to run through Dixie Valley and form a junction with the old road through Huntington Valley. Travelers generally complain about the high rates of stage fare in the vicinity of White Pine, but in a new country like that locality everything tends toward compelling the owners of stage routes to charge high prices in order to maintain the business. The fare from Hamilton to Elko, for instance, is $40, that from Elko to Hamilton $50, for a distance of one hundred and twenty-five miles. On the road to Hamilton the stage is generally well filled, carrying, say, ten passengers, but from Hamilton only five persons go on an average at a trip. When we consider the very high cost of conducting the business, the income from passengers will evidently not maintain the line, and were it not for freight and express matter it would have to be given up. The line of Len Wines on the Elko road, for instance, employs four agents, six drivers, twenty-five station men, and one hundred and sixteen horses. The pay of the four agents is $450, of the drivers $75 each, of the station men $60, and the board of each $40, aggregating $3,800 monthly. The price of barley is twenty cents per pound at Hamilton, and at Elko eight and a half cents; hay is $400 per ton at the first-named place, and $80 at the last. The price of both articles of feed increases gradually according to the distance from the railroad. One horse consumes eighteen pounds of barley and twenty pounds of hay per day, costing $5 per horse, or $580 in the aggregate daily, or for a month of thirty-one days $17,980. The expenses for repairs, &c., are about $1,000, and for horse-shoeing $470. The federal government taxes two and a half per cent. on gross receipts, which adds another $600 to expenses. Interest on capital, loss, State and county taxes would make expenses still higher, but even without these the expenses of Len Wines are $23,850 monthly. It is evident from the above that as long as high prices last for everything else stage fares cannot become any cheaper, unless the government pays hence-for the carrying of the mail, which so far has been done free of e by the stage line.

LITIGATION IN WHITE PINE.

ere has been much less litigation in White Pine district, Nevada, up e present time, than I was led to expect at the outset, from the e absurdity of the mining laws, and the locations under them, and the indefinite character of the deposits. In common with most ving men, I naturally looked for violence first, and suits at law vard. In both these anticipations I have been measurably disap- ed. Except a few weeks of last summer (characterized by a slight urst of highway robbery, stabbing, and shooting) White Pine was rkably quiet, temperate, and industrious for a new mining camp. malicious people say that so many "roughs" flocked into the dis- that there was no chance to intimidate anybody by violence, since esperate characters intimidated one another. But this explanation t the true one. As a matter of fact, roughs fight with one another than with anyone else. The reasons for the peaceableness of e Pine lie in its peculiar character and history, and are curious gh to be detailed.

the first place, the excitement concerning this district occurred at e when the mining population of the Pacific slope had learned wis- by many such experiences; and a large portion of the locators are iners, resolved not to waste what they gain, as they have so often before, in gambling, drinking, and dissipation. In the second , the ores of White Pine were, at the beginning, rich enough to make tory mining by individuals quite profitable. For months the slope hloride Flat looked almost like a placer gold-digging of the early . Each miner worked with pick, gad, and shovel in his little pit, eting in a canvas bag the rich ore he obtained. Questions of bound- vere not raised. There was, for the time being, enough room for all. ne difference existed, fortunately for the peace of the community, een this state of things and placer mining. The miner did not go his daily labor with his earnings in his pocket. The reward of his vas in the form of ore, which must be accumulated and sent to mill. e he could realize its value in money. In a placer camp everybody ush." Gold-dust forms a currency; and the temptation to spend which is money as soon as it is obtained is often irresistible to the r without means of rational amusement. In White Pine people been in a chronic state of poverty as to pocket from the beginning. n they have made money, they have made it in lumps, and gone here to spend it. But there has been no such steady dropping of plums into individual pockets as usually fosters extravagance in ng camps. Even the men who are at work for $4 or $5 per day to have caught the general infection of economy and sobriety; and omplaint of liquor-dealers, merchants, and showmen is that no ey can be got out of the people. This, I need not say, prevents that amount of violence which originates in idleness and drunkeness. lly, White Pine came sooner into contact with civilization than r mining districts. The railroad precipitated upon it a law-abiding ilation before any reign of violence could be established. Courts magistrates have been in operation from the beginning. So this nunity has been spared the era of revolvers and lynch law.

y anticipation of ruinous litigation has likewise been agreeably dis- inted. White Pine titles are not much better than they were; but proprietors of adjoining claims have in many cases preferred compromise to a struggle, which would ruin both. In many other cases they keep quiet until by selling out they can shift all possible future difficulty upon the shoulders of a purchaser. Only two or three important cases have got into the courts; but the points settled by these have covered the issues at stake in many others. On the whole, I think the result of all these decisions has been favorable to peace in the future.

Of course, the question whether there are any true fissure veins on Treasure Hill, or, rather, whether the deposits of silver ore on Treasure Hill are true fissure veins, has been brought up in several cases. It has not been legally decided in any of them, for a very good reason. It is not clear in fact, and therefore it cannot be made the subject of a definite judgment of court. I am inclined to believe that none of the principal mines thus far discovered are upon fissure veins; but I do not think that the title to a mine should turn on the opinion of a geologist. In cases so dubious as this of White Pine, square locations, which leave no uncertainty as to boundaries, would have been better from the beginning. Then the *savans* might have fought out their theoretical battles with much less danger to the public interest, and with much more likelihood of agreement. For there is nothing that disturbs the coolness of professional observers like the knowledge that money is dependent upon the views they take of some knotty questions. Men who, if left to themselves, would modestly compare their opinions with those of their brethren, become, as fee'd witnesses upon the stand, dictatorial, didactic, and obstinate.

In the Eberhardt and other cases, tried at Austin, I believe, before the organization of White Pine County was complete, it was decided that under the laws of the district any connected body of ore can be held by location to the extent claimed, whether it occurs in the form of a vein or not. This removed the necessity of abstruse geological evidence and argument for settling a simple question of title. A recent decision by Judge Beatty, in the Aurora *vs.* Earl case, fixes some other important points, one or two of which I shall mention here.

This decision contains an extra-judicial opinion, construing certain sections of the mining law to require, for the holding of a claim one year, not merely two days' work on the whole claim, whatever be the number of feet, but two days' work *on each two hundred feet.* This opinion, not being fairly within the grounds on which the case is decided, has not the full force of law; but there is little doubt that when the question comes up it will be so decided; and such an utterance, from a judge so widely known and respected, will have great weight. I fancy it will cause some uneasiness among the holders of locations who claim one or two thousand feet, and have no idea of the whereabouts of their property after the first hundred feet. It will now be necessary for them to trace it throughout its whole extent, and do work upon each section of it. This will be in many cases impossible.

Another point settled in this Aurora case is that "a wall does not make a vein." I have often heard of the numerous beautiful walls exposed in the mines of Treasure Hill. One of these, "a smooth, even surface, extending from the mouth of the incline to within two or three feet of the bottom, crossing the general stratification of the country, highly polished in places, exhibiting marks of striation, conforming very nearly, if not exactly, to its dip, (30° or 40° east,) and overlaid generally by a thin stratum of clay or soil" figures in this case. Could anything be more "true fissure vein" like than this? A wall, selvage, slickensides, lines of movement and all. Yet Judge Beatty's extremely clear decision sets the matter in its true light. Says he: "When it appears that there is *as much if not more ore* below than above it, it loses the character of a foot-wall, in my estimation. It shows that the fissure *was formed subsequent to the deposit of ore.*" The whole of this opinion is exceedingly forcible. I am glad to know that such is the temper in which the exceedingly imperfect laws of White Pine are being administered. There is common sense on the bench, whatever there may have been in the miners' meeting.

But it is clear that Judge Beatty, having (rightly) knocked away the walls from a good many mines by this *dictum*, has left the owners without any boundaries, except such as compromise or fresh judicial pronunciamentos may give in each case. The best thing about this decision is, that it helps bring matters *ad absurdum*. The miners' meeting last summer virtually refused to alter the present district laws. Of course, they cannot be forced to do so under the present mining laws of the United States, but they will surely get tired of having their titles depend on "connected bodies of ore" instead of accurate measurement.

R.

THE LATEST REPORTS FROM WHITE PINE.

The following review of White Pine gives a very interesting description of the present aspect of affairs in that locality, and the changes from an almost unparalleled mining excitement to comparatively regular business. It is taken from the White Pine correspondence of the San Francisco Evening Bulletin of January 7, 1870:

> In no mining district of which I have any knowledge have such changes been wrought in a single year as in this of White Pine. From the most violent excitement and extravagant hopes everything has dropped down to the extreme of dullness, though I can hardly add of despondency. Unimproved real estate, which one year ago was held at inordinate prices, can now be had in many cases for the taking, few caring to go to the expense of a deed or to expose themselves to pay taxes upon it. As a consequence many holders of this species of property, who twelve months ago were supposed to be rich, to-day find themselves poor. There is of course much wailing on the part of this class that they should have suffered their cupidity to so get the better of their judgment as to cause them to refuse selling when good prices were obtainable. Many who could have left the country rich had they disposed of their town lots last winter or spring are now too much impoverished to get away from the place. One year ago everybody here seemed crazy to get hold of town property—locating, buying, jumping, fighting, and resorting to almost every other means for getting possession of it, this act being sometimes effected by means of inclosure, that is, by punching a few feeble sticks into the ground at long intervals and connecting them by means of rawhide, ropes, and often with nothing more substantial than twine or tow strings. Yet this answered every purpose—it was in the eye of the law deemed constructive possession, and more than one of these claimants has been acquitted for killing trespassers on lands thus inclosed; for in the strife after this wretched and now generally worthless species of property, contention, riots, and even murder ensued. But the excitement, with its consequent scrimmages, its violence and bloodshed, is all over now—the owners of houses can now inhabit them in peace, and the possessor of town lots hold them without let or hindrance. Even stores and business places, unless eligibly situated, are scarcely worth contending for, rents having declined in nearly the same ratio as the prices of real estate. Stores that readily commanded monthly rents of $500 ten or twelve months ago, can now be had for $100, the price of choice lots having fallen in equal proportion. Of course serious disappointment has ensued to many who had counted on a certain income from investments in this description of property, while others who had built houses for rent upon leased lands have in many cases found it expedient to surrender the same with the improvements, to their landlords. Contracts entered into for the purchase of real estate have been generally ignored, no one pretending to observe or any longer attempting to enforce them.
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> And now, lest those abroad should get the impression that such a great falling off in the value of town property is indicative of a like decline in all other values, as well as of a generally distressed state of things here, I may as well say that such is not the case; that while there has been a great reduction of prices generally, this reduction has affected few other things to the same extent as real estate, and that the de-

preciation of the latter, followed by lower rents, is looked upon by our people as a most fortunate occurrence, the former prices oppressing the laborer and proving universally hurtful. In regard to losses suffered by this declension in the prices of real estate, they might as well fall upon present holders as upon any one else; since had they sold out it must have been sustained by whoever might have happened to be the purchasers. But proceeding to notice other changes, rates of wages, &c., I present the prices which obtained here for leading articles one year ago, following them with those now prevailing: A year ago hay was selling at $250 per ton; lumber, best quality, $300, second quality, $200 per thousand feet; wood, $20 per cord; barley, $20 per hundred pounds; box stoves, $75; common cooking stoves, $140; apples, 50 cents per pound; poultry, 75 cents to $1 per pound; the prices of all imported goods being in the same proportion, only those obtained from the Mormon settlements being comparatively lower. Now hay can be bought for $45 per ton; lumber, $50 to $100 per thousand; wood, $7 per cord; barley, $6 per hundred pounds, and other articles above mentioned for about one-fourth of their former cost. Miners' wages from $5 per day have fallen to $4, many being glad to work for $3. Masons, carpenters, and other mechanics, whose services commanded from $6 to $10 per day last spring, have scarcely any demand—common labor being abundant at almost any price the employer chooses to name. Millwrights, when they can get work, are still paid from $5 to $7 per day; blacksmiths being able to earn about the same wages. Good wood-choppers can make from $3 to $5 per day, with work always offering. Teamsters owning their own animals generally make good wages hauling quartz, hay, wood, lumber, &c., mostly on contract.

For hauling quartz from the mines to the mills the price is now $4 to $5 per ton, against $8 and $10 last winter. But, with good roads, cheap feed, and plenty to do, teamsters can make more money now than they could then. Now it costs $3 per ton to extract ore from the mines and $18 for having it worked at the mills—one year ago the cost was respectively $7 and $50. Other examples might be cited, were it necessary, to show the great and beneficial changes that have taken place here within a twelvemonth; for no one at all conversant with the condition of things here, or having the best interests of this district at heart, can look upon these changes as other than salutary and desirable; it being utterly impossible for any mines, however rich, to be successfully worked under such a tariff of prices as formerly obtained here. White Pine, to-day, with its diminished population and reduced scale of prices, with its empty buildings and beggared speculators, with liquor saloons closed and gambling houses deserted, is infinitely better off and more deserving the attention of capitalists and mill men than when it was crowded with idlers and infested with gamblers—some playing with dice and cards and others with mining claims. There is also more comfort and real prosperity here now than during the "flush times," when everybody made money and nobody worked. The condition of society has also greatly improved, the drones and swarms of middle-men that once infested the country having mostly departed, leaving only the industrious and such as serve a useful purpose in society behind. We have now in each of the towns here, schools, churches, and benevolent and literary societies, with a good sprinkling of women and children, men coming here and bringing their families, with the intention of settling and making permanent homes.

In regard to the weather I should have stated that this, too, seems to have changed; being, like other things, an improvement on that of last year. Twelve months ago the weather here was severely cold and blustery, the mountains being covered with snow and enveloped in "pogonip." Now it is clear and calm; the days warm and bright, with no snow and no cold mists swept by strong winds, chilling the very marrow in one's bones. The roads, instead of being incumbered with snow, or slippery with ice and heavy with slum, are now in excellent condition—hard and dry, and in places even dusty. Stock, instead of being driven to the plains for subsistence, still feed among the hills, and the Indian, rejoicing in the sunshine, continues to inhabit his "wickiup" on the mountains. It is indeed, thus far, a mild and pleasant season, and could we be certain of its holding on so to the end, one need desire no more healthful climate or agreeable winter home. With improved houses, augmented comforts, and this mitigation of the rigors of winter, the general health of our people is excellent; very few having suffered from pneumonia, erysipelas, or those other diseases which, from their prevalence here last winter, were supposed to be endemic. In fact, so far from being subject to diseases of any kind, this would seem to be an extremely healthy country; the deaths occurring here from natural causes having been very few, considering the hardships and exposure to which much of the population were at one time subject. Of the deaths in this district, a large proportion have been caused by violence; these cases being now, happily, much less frequent than aforetime, a result largely due to the lessened prices of real estate, which, from its former value and looseness of title, by exciting the cupidity of all classes was a prolific source of violence and crime.

A few facts will illustrate the extent of the present production and progress of development of the mines. The number of men now employed at mining in the district since the reduction of labor force by several of the large companies is about 600, one-half of are working on their own account. There are now 17 mills in operation, carry- out 190 stamps, each crushing 1¼ ton of ore daily, yielding, say, $60 per ton; a total product of a little over half a million dollars per month. There are now 17,000 tons of ore on the various mill and mine dumps, which, with the large ties capable of being raised, even with the present reduced force, affords suffi- eason for these companies to cut down their number of hands, without coupling ct with a "bearing" operation. It would certainly be poor economy to go on out ores in advance of the crushing capacity at command, during the short f winter, when men cannot be worked to advantage, and with the prospect of ned labor in the spring. The Stanford mill, 30 stamps, is now crushing steadily 50 tons of ore per day from the South Aurora mine, yielding something over $50 ı, or about $80,000 per month, a rate of production that can be kept up for an ite period, judging from the present appearance of the mine. The product of ne of the Treasure Hill Company is equally good in proportion to the capacity r mill, carrying 20 stamps. The mine of the Aurora Consolidated Company e made to yield just as the Aurora South, with a sufficiency of milling facilities.), perhaps, could the Hidden Treasure, the Evening Star group of mines, the ttan, the Eberhardt, and possibly the combined claims of the Chloride Flat ation Company. In fact, the producing capacity of these mines can almost be have no other limit than the milling and extracting forces employed in raising lucing their ores. The question of their permanency may also, like that of their y, now be considered pretty well settled, the continuity of the ore beds being rrupted for a depth of at least 200 feet.

ınly are the older and more extensively developed mines proving capacious and but many of those upon which less work has been performed are affording e of equal value. Of this class, the Manhattan—an early location—is now be- g to attract attention by the massive body of high-grade ore lately cut by the being driven into it. Forty feet of compact vein matter, composed largely of trated ores, has been penetrated without the tunnel having entirely traversed is mine seems entitled to rank with the Auroras, possessing a better-walled ore l than is to be found in either of these, or any of the other leading mines of the t, with the exception of the Eberhardt. Deeper explorations on the California re disclosing a greater concentration of the ores and other more favorable con- than exist near the surface. A whim, the first in the district, is now being l over the main shaft of this mine, with a view to its thorough exploration. is also in progress on the West California mine, adjoining the original location, sults that are likely to make it the peer of its older neighbor. It is a sterling ty, judiciously managed, and should the bodies of ore lately uncovered prove nt in depth, it must soon gain a footing among the big mines of the district.

ı of mining properties are taking place here almost daily, but generally in a quiet ıany of the purchasers being old and successful residents of the district. The obtained are often large, proven properties selling now better than ever before— ers can be sold at all. A ledge may be small, but it must carry good ore and indications of permanent wealth in order to get a purchaser at any price. other properties lately disposed of is the French, the Emersley, the Pogonip, thello, and the Saturday mine, besides a good many claims of less note on the etal range. The French mine is reported to have been sold for $24,000, and the ay $7,000, being a small but exceedingly rich and well-defined lode. The pur- of this last property is Thomas J. Murphy, discoverer and first recorder of the Pine district, and who has been one of the most successful operators in it. A eal of the bullion produced here is now being sent East by railroad; the quantity past two or three months having aggregated nearly a third of all turned out by lls—a circumstance that should be taken into account in estimating the yield of untry, as estimated by the arrivals of bullion at San Francisco.

e mills in White Pine January, 1870, are reported as follows:

Name.	Stamps.	Name.	Stamps.
d	30	Staples	10
tan	24	Monte Christo	10
	20	Drake & Applegarth	8
ky	20	Morten & Cutts	5
litan	15	Henderson	5
	10	Little Treasure	5
	10		
	10	Total	172
	10		

this list the Newark mill (Centenary Company) is not included, h it formerly reduced a good deal of White Pine ore.

CHAPTER XXII.

ELKO COUNTY.

RAILROAD DISTRICT.

This district was organized in June. Its boundaries are as follows: Commencing at the mouth of the South Fork of the Humboldt; thence down the Humboldt River to Palisade Station; thence up Pine Valley to the Emigrant road; thence along the Emigrant road and railroad Cañon to the toll-road, in Huntington Valley, to the South Fork of the Humboldt River; thence down and along the South Fork of the Humboldt to the place of beginning. The district was originally formed for the purpose of locating and securing extensive deposits of rich magnetic iron ore, but since then rich deposits of copper and silver ores have been discovered. The copper mines are reported to equal those of the Battle Mountain district, and the silver mines are located on the same range of mountains as those of Mineral Hill, and bear the same character. The copper ores contain a considerable amount of silver. The distance from the mines to the nearest point on the railroad does not exceed twelve miles; they are directly connected by good roads with Elko, Carlin, and Palisades. The close proximity of these mines to the line of the railroad will eventually render them very valuable.

Cope District was discovered in April, 1869. It is situated in the Red Mountains, upon the headwaters of the Owyhee River, about 90 miles north of Elko, and 105 miles south-southeast of Silver City, in Idaho Territory, to both of which places there are good wagon roads. The town of the district, Mountain City, is about five miles south of the Idaho line. Wood, water, and grass are abundant. There are a few gold placers in the district, but they are not believed to be important. The country rock is reported to be usually granite, sometimes slate, and the ores comprised chlorides, sulphurets, and ruby silver. The veins, however, appear to be frequently superficial. They strike and dip in every direction, apparently without uniformity; and it must be left to future explorations to determine whether any of them are persistent and regular.

The following were the principal mining claims in the district on the 10th September, 1869, as reported to me by P. S. Buckminster, esq.:

Name.	Course.	Dip.	Country rock.
Argenta	N. 44° E.	35° to 40° SE.	Granite.
Mountain City	N. 58° W.	Vertical.	Slate.
Fritz	N	80° E.	Slate.
California	N. 70° W.	85° S.	Volcanic at surface; granite below.
Nevada	N. 70° W.	Vertical.	
Idaho	N. 70° W.	80° N.	Slate.
Hamilton	N. 85° W.	45° S.	Granite.
Pioneer	N. 10° W.	15° E.	Granite.

Ore and gangue. Quartz carrying the minerals above mentioned, and assaying in specimens and smaller lots, $300, $400, &c., per ton. Single specimens, of course, often much richer; surface ore decomposed, often brick-red. (Query: Decomposed stephanite?)

Of these claims the Argenta is the most developed. An incline has been sunk 52 feet upon the vein, and there suspended, as no quartz was found for the last few feet. A cross-cut is now running in search of ore. The quartz seems to lie in gusset-shaped seams, with granite intermixed. The opening on the Mountain City was four feet deep; on the Fritz, six feet; on the California, ten feet. The latter showed considerable mass of quartz, but broken and disappearing at the bot-om. The Nevada is opened to a depth of eight feet, and the Idaho six eet; the latter with well-defined casings, but disturbed vein matter. The Hamilton incline, 25 feet in depth, is similar in appearance to the Argenta; the quartz seems to give out at 20 feet. The Pioneer is opened ight feet in depth.

The only force at work upon these claims, at the time mentioned, was: wo men on the Argenta, running a cross-tunnel for the vein; two men inking the Hamilton incline; and one man running a prospecting tunnel on the California, to find the vein lost in the shaft.

CHAPTER XXIII.

HUMBOLDT COUNTY.

A very full account of this county having been given in my last report, I will merely refer to the operations of the past year, mentioning he districts in alphabetical order, as before.

Buena Vista district.—The Arizona still continues to be the leading ine. The original location is owned by Messrs. Fall & Temple, and he first extension south by the Silver Mining Company, a Nevada corporation. This mine has been steadily improving in character the last ear. At about one hundred and fifty feet depth the vein is six feet ide and yielding large quantities of native silver.

The subjoined schedules give the general details of this mine. It will e observed that the returns do not cover the whole of the mining year; all & Temple's returns being for only ten months, the Silver Mining ompany six months, and the Pioneer Company only five months.

The Seminole Company, a New York corporation, is prosecuting a rospecting tunnel on its ledge. They are in now about two hundred nd fifty feet. Two hundred feet of this was run in previous years. he present contract is for one hundred and fifty feet or until the ledge s struck, which they expect to do before the contract is finished. This edge is one of the oldest locations in the district and has long been eld in high esteem.

Work is also being prosecuted on the first extension north of the Arizona, by the original locators. The same character of ore as that ound in the original claim and the first south extension has been struck; but there has not been work enough done on it yet to determine its value.

The National Company is resuming work on its ledge and erecting a -stamp mill on Buena Vista Creek. This company's ledge yields argely in gold, an exception in this district. All of the mills in this district have been improved during the last summer and the capacity of ach of them increased.

Quite an impulse to mining was given in this district last year by the introduction of Chinese labor in the mills by John C. Fall, of the Arizona mine, thus greatly cheapening the cost of reduction and bringing into profitable working a large amount of ore formerly rejected. The miners resisted at first, and drove the Chinese out of the district; but the latter were immediately brought back and reinstated in their places and by common consent allowed to remain, many of the leaders in the demonstration against them acknowledging that in using force they

had committed an error in policy. There is no probability of any fi
ther disturbance on this score. At Fall & Temple's 10-stamp m
Chinese sort the ore, feed the batteries, attend the pans, and do nea
all the work about the mill.

Another change was made in labor, abolishing the three 8-h
shifts per day, and putting on two shifts of ten hours each. The min
struck, not objecting to the increased time of labor, but demandin
corresponding increase of pay; but the mine owners refused to yi
and labor was resumed in a few days at four dollars a day for ten ho
work.

Mill.	Owners.	Location.	Mine.	Number of tons ore.	Average yield.	Total product.	Time of running.	Average number stamps running	Whole number stamps in mill.	Power.
Fall & Temple.........	Fall & Temple..............	Unionville......	Arizona and Manitowoc.....	2,400, ore and tailings.	*$40 00 *20 00	$80,000 †15,000	*10 months	10	10	‡40
Pioneer	Pioneer & Inskip Mining & Milling Co.	Unionville......	Manitowoc and Arizona and Moonlight.	* 500 tons ore, 600 tailings.	35 00	20,000	5 months 4½ months	......	8	§40
Silver Mill.............	Silver Mining Company.....	Unionville......	Arizona Southern Extension.	1,360 tons ore and tailings.	*40 00 *20 00	40,000 †9,500	*6 months	5	5	‖25

* Estimated.
† On selected ore shipped.
‡ High-pressure steam-engine. This mill has a capacity of twenty stamps, both in power and room. § High-pressure water-wheel
‖ High-pressure steam-engine; capacity of mill is of a 10-stamp mill.
Remarks.—No gold is obtained from these mills. There is only a trace in the ores worked.

Estimate of costs of mining and reducing ores in Buena Vista district, Humboldt County, Nevada, July 1. 1869.

Wages of first-class miners: Four dollars a day, or three dollars and board.
Wages of second-class miners: Not known here.
Wages of surface laborers: Three dollars to three dollars and fifty cents per day.
Cost of lumber per thousand: Fifty to sixty dollars.
Cost of mining timber: Twenty-five cents to two dollars a piece.
Cost of common powder: Five to six dollars.
Cost of giant powder: None used yet.
Cost of quicksilver: Sixty-five to seventy cents per pound.
Cost of freight from base of supplies: Sixty dollars per ton.
Cost of fuel: Ten to twelve dollars per cord for cedar wood.
Cost of ten-stamp mill, California pattern: Freight, *twenty thousand dollars.
Cost of twenty-stamp mill: Freight, erection, *thirty-five thousand dollars.
Average mining cost per ton: Twelve to fifteen dollars.
Average milling cost per ton: Twelve dollars.
Average pulp assay of ore: Sixty to one hundred dollars.
Average yield of ore: Thirty to sixty dollars.

Remarks.—Indian laborers, employed about the mine, get from $1 50 to $2 50. Very little lumber is used in the mines. Timber is used to support loose parts of the rock, and mostly for support in stoping. The mines being yet in their infancy, much dead-work has been done, increasing the average cost of mining per ton. The assay of the pulp varies a great deal. It should be understood that the assay of the pulp does not show the average value of the ore, since the richest part is selected and shipped to San Francisco, &c., for smelting. The lots of ore shipped assay from $300 to $700 per ton. Of the mills erected during the year, one was put up before the railroad was completed, and, therefore, no benefit was derived from cheap transportation, and the other was built by contract, with a loss to the contractor. Besides, one is of the capacity of twenty stamps, but has only ten stamps, and the other is for a 10-stamp mill, but has only five stamps. Therefore, the cost of a 10 and 20-stamp mill can only be estimated as above, considering the cheaper transportation obtained at the present day.

BATTLE MOUNTAIN DISTRICT.

This district is in a very flourishing condition. The Little Giant mine continues to hold the first position in the district. The Little Giant mill (steam, five stamps) has been running steadily for about a year, and crushes six tons daily. The rock yields from $150 to $280 per ton, without roasting. Bullion from .980 to .998, fine; no gold. This mine is situated on the eastern slope of Battle Mountain, eight miles from the Central Pacific railroad, by the usually traveled road, or about five miles in a direct line. There are three tunnels already run on the ledge. The lower tunnel is about 240 feet in length. Work is being prosecuted in all the tunnels. This mine is owned by Governor A. P. K. Safford, of Arizona, and Messrs. McBeth, Fox, and Melander, of Humboldt County.

The Brooklyn Company, a New York corporation, is working copper mines in this district, sinking shafts on three different ledges, extracting ore from all, and shipping it to Swansea, in Great Britain. Their ore contains some silver, in what quantity I am not informed.

The Great Central Company, a San Francisco company, is also working in copper and shipping it by rail.

In Copper Cañon, in this district, about eight miles south of the Little Giant ledge, two or three companies are extracting copper ore.

An English company has also been formed in Liverpool to operate in copper in this district, and is about commencing active work.

Messrs. Whitcomb, Briarly, and Lott are working a copper vein on the west side of Battle Mountain, quite distant from the other workings. The ore gives by assay fourteen per cent. copper, and $475 80 silver per ton.

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*Estimated.

Mr. Fox, of the Little Giant, is prospecting the Buena Vista series of dges, silver-bearing.

It is not probable that any more mills will be erected in this district. he ore will doubtless be shipped to the Truckee River, at the eastern ase of the Sierra Nevada, for reduction by roasting and smelting. The evada Land and Mining Company, (limited,) a London company, has rected at its works in Reno, on the Truckee, under the supervision of r. Stelefeldt himself, a Stelefeldt chloridizing furnace, mainly for the duction of Humboldt ores.

The bulk of the Battle Mountain ores can be freighted from the mines the railroad for $5 per ton, and thence to the Truckee for about $7 dditional per ton.

ECHO DISTRICT.

This district is in the Star range of mountains, on the slope facing e railroad, and about one hundred and twenty miles distant from eno. The Alpha is the prominent mine of this district. It was disvered in 1863 and worked for about a year by a California corporation. e work was confined entirely to the surface ore, which yielded from 00 to $400 per ton; but as the amount obtained by superficial working as necessarily limited, the yield from this source soon dropped off, d a reaction in mining affairs in Humboldt County setting in by ason of the excitement about Reese River, work on the Alpha was opped and not resumed until 1868. At this time some of the sharelders most familiar with the mine took a contract from the company open the ledge for the privilege of extracting four thousand tons of e. They sunk a shaft 6 by 6 feet to the depth of 120 feet, exposing a e vein of ore eight feet wide and assaying from $60 to $2,000 per ton. e ore mined in sinking the shaft (107 tons) gave an assay value of 10,565, and yielded, by mill process, $6,332. This mine has lately been rchased by the Nevada Land and Mining Company, the English mpany before referred to, which has extensive reduction works on the uckee near Reno, under the superintendency of J. J. Dunne, esq., neral manager of all of this company's property in Nevada. Since e purchase of the mine by this company, work has been vigorously osecuted. The shaft has been deepened 30 feet and a tunnel run to nnect with the bottom of the shaft. Another tunnel is now being run hich will strike the ledge at a depth of about 350 feet. Two hundred d fifty feet of this tunnel is now completed. About thirty men are ployed at the mine, and new hands are put on as fast as they can et room to work. The company is now extracting about 12 tons of ore er day. The ore is hauled in wagons to the railroad, a distance of three iles, at a cost of $2 25 per ton, and freighted thence by rail to the ompany's mill at Reno, one hundred and twenty miles, at a cost of 3 50 per ton. The claim is 2,100 feet in extent. The vein can be traced n the surface by the outcrop for about 1,800 feet, and worked by tunels to the depth of 500 feet. The dip is about sixty degrees west. here are no signs of any heave or break, unless it be at a point about 00 feet from the north end of the claim. There is a good deal of sulhur in the ore, which prevents successful reduction by the common rocess; but the mill at Reno has been altered from the wet to the dry rocess of crushing, and furnaces built to roast the ore. The richer ortions of the ore are shipped to England through Rogers, Meyer & o., of San Francisco. The operations on this mine have attracted a reat many persons to the district, and quite a number of the locations ade in former days are now being prospected. This district being only three miles, by a down-grade, from the railroad, a good location here has a special value.

GOLD RUN DISTRICT.

This district continues in about the same condition as set forth in my last report. The New York Company, of which Mr. Negus is the superintendent, which first bought half of the Golconda mine, has lately bought the remaining half and is now working the whole mine quite successfully. There are some very fine base metal ledges in this district awaiting capital for development.

HUMBOLDT DISTRICT.

The only change worthy of note in this district since my last report is, that the bed of sulphur mentioned therein is now being worked, mainly with Chinese labor, by W. & J. Spence, of Unionville. The sulphur is shipped to San Francisco by railroad.

ORO FINO DISTRICT.

The Yosemite mine, mentioned in my last report, is now being worked under the superintendency of J. T. Maclane, with satisfactory results. The work thus far done is mainly in the nature of prospecting. A streak of black sulphuret ore, assaying from $2,000 to $4,000, has been struck in the shaft. This rich streak is now about five inches wide. The mine is about ten miles from the railroad.

SACRAMENTO DISTRICT.

There is considerable work doing in this district in prospecting old claims. The Rochester Company, Mr. Onderdonk, superintendent, is prosecuting work on its location on the Montana ledge, with great vigor. Great interest is felt in the operations upon this ledge. It is the largest one in this portion of the country, and being only five miles from the railroad, will be an immense affair if it proves as rich as expected.

SIERRA DISTRICT.

During the past year the Tallulah, Gem, and one or two other mines have been worked to a limited extent. The prospects are, that work will soon be resumed on the Monroe also.

STAR DISTRICT.

There has been but slight movement in mining matters in this district during the last year. The Sheba mine was opened again, and a small amount of ore taken out on the contract system. The same was done with the North Sheba. The De Soto Company (first extension south) worked five men for a little while during the summer, but no regular work can be said to have been done on the Sheba vein during the past year. E. Page Davis has resumed work on the Almira series for a New York company. He is now driving in the tunnel formerly started. It is in now about 150 feet. There was some excitement in this district last summer over gold-placer diggings. The deposits were found on Star Creek near the mouth of the cañon. The gold was very pure and quite coarse and rough. The particles ranged from the size of a small bean, as maximum, to a mustard seed, as minimum. The prinortance attached to these discoveries was due to the belief indicated the existence of gold-bearing quartz ledges in the ove. Gold has been found on the banks of the creek in Star and a half miles above, but the particles were much finer than d at the mouth of the cañon. Gold placers were also found the opposite side of the mountain near the summit.

WINNEMUCCA DISTRICT.

Buck and Kunkel have been extracting ore steadily for the under contract, from the Pride of the Mountain ledge, and he ore by rail to San Francisco. They are down 150 feet and g very rich ore. They have lately found considerable quanti- n-silver, the presence of which in this district was not suspected Ir. Pease is directing the operations of a New York company ion Series mine.

WHITE CLOUD DISTRICT.

district lately discovered near the Humboldt Lake. Some very neus have been brought in from the Moonta, a ledge named ebrated mine in Australia. A great number of locations have e, but little has been done as yet to test their value.

whole, the condition of Humboldt County may be considered s and full of promise, not only as to the mining interest, but in ches of industry. There is perhaps no other mineral district ute of the railroad which has been so much benefited by its n. Freights on supplies have been reduced from fifteen cents l to two and a half cents. This makes it possible to extract nany mines which before could not be touched, and, moreover, a cheap and speedy means of transportation to points where is cheaper. As the cost of transportation is reduced, the for mills will diminish, and the ore will, to a great extent, be the base of the Sierras, where wood and labor can be obtained pense. A reference to my report of last year on this county that I was fortunate in my predictions, as the effects which I old are already coming to pass. Abandoned mines have been again with vigor and success. The great revolution in the miners has come to pass, and base metals, especially copper, me ingredients, enhancing the value of the ores. This com- d economical progress coincides most happily with the great ical improvement inaugurated by the Stetefeldt furnaces, a n of which is given elsewhere in this report, and the effect of l be nowhere more beneficially felt than in the mining districts ldt County.

CHAPTER XXIV.

ESMERALDA AND LINCOLN COUNTIES.

RED MOUNTAIN.

my report for 1868, the Silver Peak and Red Mountain Gold r Mining Company have continued the development of their commensurate with the plans marked out at the beginning. e built and put to work another battery of ten stamps, so that they have thirty stamps now running. Their mill is one of the most substantially built and perhaps the most regularly working on the Pacific coast. It has been running at full capacity ever since June, and the profits derived have been used to still further develop their property and to enlarge and improve the works. They have added self-feeders to all their batteries, every five stamps, or one mortar, having a separate feeder. This improvement saves fifty per cent. of the usual cost of feeding the batteries, only half the former number of men being required for that work. Other machinery has been added with success during the year, for the purpose of economizing labor. Shops, storehouses, lodging-houses, boarding-houses, and offices, all substantial buildings, have been added; a large farm has been put under cultivation to raise supplies for man and beast, and a good, direct, and easy road has been built from the works to Wadsworth, on the Pacific railroad.

The skillful use made of the natural advantages, which the location offers for mining on a large scale and at an extraordinarily low cost, has been described in my last year's report. The company have now made an open cut along the whole side of the mountain, on one of the veins, which is to serve as a base line. Starting from it, they quarry out the vein, which is denuded almost entirely from its hanging wall and resting on the slope of the mountain from 12 to 20 feet thick, by overhand stoping. This mode of working, which offers such great advantages, even under ground, is, of course, still more to the purpose in a location where all the work can be performed in the open air, where there is no resistance to the blast except the tenacity of the rock itself, and where the whole side of the ledge is in full view for a height of 1,000 feet above the base line. The whole expense of raising water and ore, a heavy tax on the mine owner in the best mines, is thus entirely dispensed with. Here all the ore quarried descends to the base line and thence to the mill.

The mill employs, including engineer and fireman, only five men and the superintendent. The cost of working the ore is expected to be only $4 per ton henceforth.

The unmistakable abundance of the gold-bearing ores, their known value, the light cost of mining and transportation, the extraordinarily low rates of milling, combined with cheap supplies and the company's judicious and liberal outlays for the purpose of securing complete unity and economy in all the operations, bespeak a bright future for this remarkable undertaking.

PAHRANAGAT DISTRICT.

In my report for 1868 I gave a brief description of the features of this district, and a summary of the results of mining operations up to that time. The grand totals of expenditure and production were not encouraging. It appeared, from the best information I could obtain, that nearly a million dollars had been spent in roads, dwellings, mills, prospecting and mining, and only $20,000 worth of bullion shipped.

The following sentence from that report contains the key to this state of affairs: "The developments in this district are both costly and extensive, but have been conducted with such conspicuous absence of skill and common sense, that they may be said to have produced hardly any results whatever. On the one hand, no mine has yet been made productive; and on the other hand, scarcely any have been so thoroughly explored as to render their unproductiveness a matter of rtainty. But few companies are now at work, and it is to be hoped at these will persevere until the actual value of the district is ascerined."

The successive discouragements and disappointments attendant upon e labors of nearly four years, and the excitement produced by the dden development of White Pine, caused most of the mines to be andoned. At last only one important enterprise was left in active eration, and it was reserved to that one, the Hyko Company, working on the great vein of the same name, to retrieve the waning fortunes Pahranagat. The unusual perseverance and courage with which this mpany has pushed forward its work, until it has arrived at a point here success appears no longer visionary, deserve the highest praise

The authorities of later date than those on which I based my last rert are the following:

1. A very elaborate and careful report on Pahranagat, by Herr Bergferendar Carl Haber, of Prussia, published in the Berggeist, of Cogne, in December, 1869.
2. The preliminary report of a military reconnaissance through Southn Nevada, by Lieutenants George M. Wheeler and D. W. Lockwood, ' the United States Engineers, dated San Francisco, January 21, 1870.
3. The report of Mr. John H. Forster, State engineer of Michigan, ho examined the mines early in 1869.
4. The report of Mr. A. F. White, mineralogist for the State of Neda, who examined the mines in August, 1868, but whose observations ere not accessible to me at the time of my former report;
5. The files of the Engineering and Mining Journal.

From the mass of information thus furnished I condense the following atement:

Pahranagat Valley is situated nearly in the geographical center of ncoln County. The best routes from the Pacific railroad to Arizona ss through it, as is shown by Lieutenant Wheeler's tables, two of hich are presented herewith in a condensed form.

stances from Toano, on Central Pacific railroad, to Prescott, Arizona, via Egan Cañon, Murray's Creek, and mouth of Virgin River.

Toano to—	Miles.	Miles.
n Cañon. (estimated)	80	....
rray's Creek. (estimated)	40	120.00
Creek	16.16	136.16
e Cave	28.80	164.96
tterfield's Springs	20.92	185.88
k of Sierra Creek	16.67	202.55
nond's Springs	31.67	234.22
ko	19.12	253.34
uth of Virgin	134.85	388.19
escott	170.26	558.45

Of this route Lieutenant Wheeler remarks: "In case further develments prove that the distances marked 'estimated' in the above table e on feasible routes, the above line of communication will be the acticable one of the future for through travel from the Central Pacific ilroad to Arizona. All distances, except those marked 'estimated,' ere measured during the trip." The estimated distances to which he ludes include the route from Toano to Murray's Creek, and the route om the Virgin River to Fort Rock Springs, seventy-eight miles from escott. The latter route, comprising ninety-two miles, I know nothing out. Of the former, between the railroad and Murray's Creek, I have good authority for saying that it offers one of the best natural roads in the world, passing through the magnificent Steptoe and Goshoot Valleys. A part of it, amounting to perhaps fifty miles, (the whole distance is one hundred and twenty miles,) I myself saw in 1868.

Distances from Elko, on the Central Pacific railroad, to the mouth of the Virgin River, and so to Arizona, via White Pine and Pahranagat.

Elko to—	Miles.	Miles.
Crescent Station	7.83	....
Willow Creek	16.09	23.92
Overland Road Station	38.00	61.92
Big Tent	34.25	96.17
Monte Cristo Mill, (White Pine)	26.10	122.27
Yokum's	17.62	139.89
Currant Creek	19.27	159.16
Silver Cañon, (estimated)	55.00	214.16
Hyko	9.50	223.66
Mouth of Virgin	134.65	358.31

This route does not differ from the other south of Hyko. North of that place, which is the principal town of Pahranagat, the Egan route reaches the railroad in two hundred and fifty-three miles, and the White Pine route in two hundred and twenty-four miles. Whichever shall become hereafter the general line of travel, this district will secure the advantages of the communication. The mouth of Virgin River is just above Colville, on the Colorado River. If the navigation of this river should be improved, or even if suitable steamers should attempt it, the communications of the district would be cheapened and shortened. At present it is folly to rely on the navigation of the Colorado above Fort Mohave, or even up to that point; and the vexatious delays and disasters attending the transmission of freight by that route render it for the time being quite impracticable.

The valley contains 15,000 to 18,000 acres of arable land, a considerable portion of which is available for cultivation without irrigation. Although the distribution of water is unequal throughout the district, the amount is sufficient for the irrigation of the land requiring it; and the height and disposition of the mountain ranges, together with the occurrence of several powerful springs, the water of which is under considerable hydrostatic pressure, indicate very clearly that artesian wells, suitably located, would increase the supply. Lieutenant Wheeler puts this valley next to Ruby Valley, (the ranches of which are celebrated as the best in Nevada,) as to the amount of its agricultural land.

A description of the geological features of the mineral belt of Pahranagat is to be found in my former report, page 113. It is sufficient here to remark that the principal ore deposits extend along the precipitous eastern slope of Mount Irish or Great Quartz Mountain. There are numerous fissures, running apparently in every direction; but the sum of all explorations up to this time seems to show that there is but one master lode, generally called the Hyko lode, coursing nearly parallel with the crest of the range, (not far from north and south,) dipping easterly, and traced on the surface and by mining for a distance of five miles. According to present appearances, all other ore deposits of the district may be considered as subordinate to this. Several cañons, of which Silver Cañon is the deepest, cut across this lode, affording numerous opportunities for access at considerable depths by adits on the vein itself. This favorable topographical feature is one of the most important elements of success in developing these deposits on a large working scale. The depth of Silver Cañon below the summit is [illegible]

:t; below the lowest tunnel in the cañon, a little over 500 feet; and low the lowest point ever reached on the lode (the bottom of a shaft Cedar Cañon) on the south, nearly 400 feet.

The distance to Hyko is nine and a half miles, by an excellent road, the way down-grade. The company's mill is situated at Hyko, on ount of the water supply; but an artesian boring is now going on in :er Cañon, which is reasonably expected to furnish water for the ıers and possibly for milling purposes also. As will be seen in the uel, however, the company has accepted the present situation, and ed its plans for the future upon the supposition that transportation ıres to Hyko will remain, as it now is, an unavoidable necessity. If sequent success in boring shall enable the beneficiation to take place rer the mines, so much the better.

t remains to be observed that, while timber and fuel are not abun- ıt in the valley itself, the mountainous mineral belt affords a supply ısually large and valuable. In this respect, scarcely any mining dis- ·ts of Nevada are so highly favored.

ìuch being the natural conditions which surround this enterprise, the ıowing are the results of operations thus far, and the prospects for future. The various claims known as the Illinois, Indiana, Soledad, imney, Cocomongo, and Yellow ledges are parts of the Hyko lode, d all belong to the Hyko Company. The company has acquired the le also to numerous outlying and diverging locations, which, before e establishment of a main master-lode, were considered to be inde- ndent and of equal value, but which, for the present, principally serve secure the whole of the Hyko, with all its dips, spans, angles, and ık-deposits, against piratical or interfering locations, and consequent :igation.

It is not necessary to recapitulate here the developments made upon ie various claims of the lode. This company, like all the rest that ıce flourished in Pahranagat, committed serious errors in their prelimi- ıry work, and the result was an enormous expenditure, without any :ward in the shape either of profits or of definite knowledge. Within ıe past two years, however, the explorations have borne valuable fruit. ıe vein has been extensively exposed in the Illinois and Indiana—two ıjoining claims, on both sides of Silver Cañon—and the following facts ıe testified to by all the authorities I have mentioned.

The Illinois is opened by a shaft and three tunnels. Of the latter, the pper one is quite near the surface, the second cuts the shaft 187 ·et below the surface, and the third, 288 feet below the surface. All ıese tunnels show, wherever they expose the vein, a lode of the average idth of 21 feet, containing chimneys of rich ore, and an almost uni- rm mass of low-grade ore. The Indiana, which has been opened with shaft and a tunnel, shows in places a much larger fissure—at one point ı feet in width—and the same general characteristics. In the begin- ng of mining operations, it was intended to pursue the policy, so com- on and so ruinous in Nevada, of working only the first-class ores, and rowing away the rest. But the rich bodies of first-class ore were soon :hausted, and to the eyes of the miners, the ore of low grade was no :tter than barren rock. Thus it came to pass, for instance, in the List remote claim to the south) and the Illinois, two of the best known ines, that the rich bodies of pay ore first struck extended some 40 :t below the croppings, and, as I remarked in my former report, wn to 180 feet, no more material was found which would pay ex- nses. Now the material remains, of course, to-day just what it ıs then. No doubt other rich chimneys of ore might be discovered in e course of explorations; but the character of the vein is that of a huge, regular mass of low-grade ore, and the true and only basis of a mining industry upon it is the profitable extraction of low-grade ore. I have had frequent occasion to enforce this principle, which is so universally applicable as almost to warrant the declaration that the average mill-yield of ores per ton in any active district is in inverse relation to the soundness and prosperity of mining in that district. As a general rule, after the first crop of lucky bonanzas has been gathered, and the operations of regular mining have begun, a high yield in the mills indicates, not so much the extraordinary value of the deposits, as the great cost of working them. This will appear if we consider the fact, that rich ores do not occur alone. For every ton of ore worth $1,000 there are likely to be two worth $500 each, or ten worth $100 each, and so on; and these poorer ores are so associated with the richer, that they must be penetrated, and often extracted, before the latter can become available. It is therefore usual to separate, by rude hand-sorting upon the dumps, the ore that will pay for reduction, and throw the rest away. But the rich ore must thus pay also for the extraction of that which is discarded. For instance, suppose the items of expense are as follows:

Extraction per ton	$10
Transportation per ton	8
Mill treatment per ton	34
Total	52

Add to this the loss of say twenty per cent. in treatment, the heavy taxes of the State on production, (one and a half per cent. on all over $40 per ton,) and the interest on capital, and it will be found that $70 per ton is required to pay expenses. But in sorting ore, the first class must be considerably richer than $70, since it has to bear the cost of extraction and sorting for the whole. Thus, if five tons are extracted containing in the aggregate $200, it is evident that they cannot be worked with profit. If two tons are sorted out for reduction, they must contain at least $90 each to pay expenses, thus:

Extraction, 5 tons	$50
Sorting and handling	10
Transportation	16
Reduction	68
Loss, taxes, &c	36
Costs on two tons	180

If one ton only is saved, it must be worth at least $120. Yet one ton in five is a better proportion than I have generally found in mines where ore of high grade only is sent to mill. These considerations justify me in the opinion that high milling-yields are frequently but the indication of high costs, and consequently of wasteful and short-lived mining. It is only low-grade ores that can be relied upon with any degree of confidence as to quantity, and it is only where such ores are profitably worked that mining has found a permanent foothold. The reduction of expenses by ten dollars a ton is a more important and profitable discovery than the exposure of the richest outcrop that ever was seen.

In the case of the Hyko lode, this course of reasoning is emphasized by the teaching of experience, which shows hand-sorting to be practically impossible. The ores of this vein consist of stetefeldtite, and, near the surface particularly, argentiferous galena and chloride of silver. *Probably*, at some depth much greater than has yet been reached, the more permanent sulphurets of silver will make their appearance. Now

nerals are very rich in silver, but they are so finely disseminated
gue of quartz and calcspar, that hand-sorting is impossible.
e company must be able to beneficiate low-grade ores, of which
immense supply, or it must give up the problem as too diffi-
solution.

eat progress made during the past two years is the adoption of
hich promises to effect the profitable reduction of these poorer
err Haber, by an elaborate calculation, arrives at the figures
which I have hypothetically given above, as the actual expense
nagat district two years ago. Having satisfied itself by actual
nents that the amount of available ore will justify the extensive
ditional capital, the company is now about to inaugurate oper-
a a large scale. The means of reducing expenses are the fol-

the cost of provisions and materials and the rate of wages
tably declined. Wages are now but $4 currency, where they
merly $6; and so on, in proportion. A still further reduction
feasible. I need only point to the Red Mountain Company at
'eak, Nevada, where cheap labor ($2 per day, I believe) is suc-
employed.

d, the cost of transportation is to be reduced by the employment
ction-engine, with a train of cars, which will take 80 or 100
a load from the mines to Hyko.

, the cost of extraction is to be reduced by employing large num-
men in the great stopes which the extraordinary width of the
l now permit, and by opening additional ground by means of
nels from Silver Cañon.

h, the cost of treatment is to be reduced by the employment of
efeldt furnace instead of the reverberatories hitherto used for
paratory roasting of the ore with salt.

the proportional cost of administration is to be reduced, by en-
the operations, so that the items of general cost now chargeable
tons of ore may be distributed upon a great many.

, the cost of taxes upon bullion product is to be reduced by work-
grade ores, which pay little or no taxes.

th, the cost of sorting is to be, as far as possible, done away
er.

mpossible to say exactly what will be the saving per ton in the
numerated; but the following comparison is probably not far
e truth. The first column gives the estimates, based upon
report, and showing the former state of affairs. The second
comprises the figures to which each item of expense may rea-
be expected to be reduced:

	Per ton.	Per ton.
of ore milled	$5 00	$5 00
of ore not milled, chargeable to each ton of ore milled	10 00	
	5 00	
tion to Hyko	8 00	3 00
ent	34 00	20 00
tion, &c	4 00	1 00
tal	67 00	29 00
ore	1 00	
ore		15
l on $120 ore	24 00	
l on $50 ore		10 00
	92 00	39 15
t on 16 tons $120 ore	448 00	
t on 100 tons $50 ore		1,085 00

But it must be borne in mind that even 16 tons daily of selected rich ore cannot probably be obtained, while the amount of low-grade ore that can be extracted is declared by all who have examined the various openings in the vein to be far beyond what I have assumed. The company declares its intention to work ultimately 390 tons per day. Single mines on the Comstock ledge have frequently done much more than even this.

With regard to the item of transportation, which I have put down at $3, I must add that I do not know what the traction-engine will be capable of performing; but I am satisfied that on a uniform downgrade, ore can be hauled twelve miles for $3 gold per ton. This figure is below the average of Eastern Nevada, I know; but a fair precedent may be found at Silver Peak, where the Red Mountain ores are hauled over six miles by mules, at a considerably smaller rate. Experiments are about to be made with the traction-engine, previous to its adoption by the company, and, in the absence of exact data concerning its performances, I have put down a sum which, if successful, it certainly ought not to exceed, and at which I am sure that mules could do the work, on a properly graded road. (See my report for 1868, page 116.)

The following table shows the saving by the use of the Stetefeldt furnace, and the present low wages:

Costs of roasting forty-eight tons daily.

Haber's estimate:	
Wood, 38 cords, at $10	$380 00
Salt, 5.7 tons, at $60	342 00
Wear, repairs, &c	63 00
Labor, 45 roasters, at $6	270 00
5 carmen, 5 pulp-coolers, 5 ore-men—in all 15 men, at $6	90 00
Total	1,145 00
Cost per ton	23 85
Present estimate:	
Wood, 5 cords, at $8	$40 00
Salt, 2.8 tons, at $45	126 00
Wear, repairs, &c	25 00
Twenty men, at $3 50	70 00
Total	261 00
Cost per ton	5 70

The allowance of $14 30 per ton, which I have made for the mere crushing and amalgamation, is altogether higher than the probable cost. Indeed, Haber's own estimate, on the basis of high prices for everything, leaves only about $11 for crushing and amalgamation proper; but his estimate for fuel probably includes that of the steam-engine.

To recapitulate. The progress achieved in Pahranagat amounts to this:

1. Explorations have determined which is the principal, permanent, and most promising lode of the district. This lode has been brought for a continuous distance of several miles under one ownership, and vigorous mining operations have been concentrated upon it, all distracting and wasteful outside ventures being for the present suspended.

2. It has been ascertained that this principal vein carries, between the well-defined, smooth walls of a wide fissure, an immense mass of ore, chiefly of low grade; that it cannot be properly sorted, and that it

ıst be beneficiated by reducing to a minimum the costs of extraction, ndling, and reduction.

3. The fortunate decline in wages, and the introduction and success the Stetefeldt furnace, have come to the assistance of this plan, and system of operations has been proposed which promises success, not reason of supposed extravagant richness of the ores, but, acknowl- ging the general low grade of ore, by reducing the costs of its utili- tion.

Accepting, therefore, the statements of those recent observers, from iose reports the foregoing information is derived, I am justified in garding the prospects of this district as more truly promising than ey have ever been before.

The total amount of bullion produced in the district during 1869 was ıall, probably not exceeding $80,000.

TEM PIUTE.

This district is situate in Pahranagat, Lincoln County, in the extreme uthern part of the State. The country rock is dolomite and slates, hich dip to the east, at an angle of about 55°. The "veins" dis- vered and located so far run north and south, and vary in thickness om one to ten feet. They dip with the country rock 55° east. Two ins, running across the stratification of the rock, and dipping 85° rth, make an exception. One "vein," consisting of calcspar, im- egnated with chlorides throughout, and 50 feet wide, has been dis- vered in the district, and named the Inca. The Savage, Demerara, asterpiece, Real del Monte, Santa Cruz, Silver Peak, Emerald, Wyan- tte, Bank of California, Lady Bell, Thornburg, Rattler, Sunderland, insey, Pride of the West, Defiance, Realito, Juniata, Belvidere, iticaca, Arlington, Blue Bell, Valley Vein, Mountain Chief, Monarch, ittle Giant, General Sarsfield, Brian Bohrome, Eureka, and Indian ick, are all located in the district, and the specimens brought from ost of them to Hamilton have all yielded by assay from $72 to over ,000 per ton. The greatest drawback for the rapid development of e district is the want of water, which has to be brought to the mines om springs six miles distant. Timber abounds in the region.

SECTION III.—OREGON.

CHAPTER XXII.

GENERAL REMARKS.

The natural resources of this State, aside from mining, are set forth in the report of J. Ross Browne (1868) with comprehensive clearness. In climate, soil, navigable rivers and harbors, Oregon is highly favored, and creditable progress has been made by her citizens in the development and utilization of these advantages. The attractions of the State are indeed so great and so generally known, that a stream of immigration is constantly pouring into it, and would continue to do so, if there were no mines to be worked for gold and silver in that region. In many parts of Oregon, however, as elsewhere on the Pacific coast, mining has been the pioneer of settlement and civilization. It may confidently be expected that the growth of a diversified industry will react favorably on that branch which gave the first impetus.

Mr. Browne's report describes the great iron deposits of the State. I regret to say that the manufacture of iron is not yet successfully established, though the quality and abundance of the ore leave nothing to be desired. The difficulty lies in the high price of labor, and can only be remedied by the employment of Chinese. The woolen manufacture, into which Chinese labor has already been introduced, is thriving and extending.

Coal is found in Columbia, Clatsop, Coos, Tillamook, Benton, Jackson, Douglas, and Clackamas Counties. A considerable export has sprung up, and coal-mining promises to become a stable and profitable business. The abundance and excellence of the lumber of Oregon are well known. The salmon fisheries of the Columbia are a source of considerable revenue. The gross receipts of the salmon catch of last season are estimated at not less than $275,000.

One of the prominent industries of the State is stock-raising. Oregon horses are highly prized throughout the Pacific States and Territories, and Oregon cattle are driven in great numbers south into less favored regions.

With this slight preliminary allusion to the frequently described natural resources of the State, I proceed to consider more at length its mineral wealth, especially with respect to gold and silver, principally the former.

The production of Oregon and Washington is usually reckoned together, as the shipments of the latter Territory are made to Portland. The treasure shipments of Wells, Fargo & Co., from their Portland office, have been as follows:

1864	$6,200,000
1865	5,800,000
1866	5,400,000
1867	4,000,000

1868—January	$
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	
Total	3,

The bullion shipments of Messrs. Ladd & Tilton, bankers of Po during 1868, amounted to $640,850. As Jackson and Josephine ties do not always ship to Portland, there is a considerable sun added for those counties, while, on the other hand, there are so ductions necessary for gold from Idaho, finding its way to the Col My estimate of $4,000,000 for the yield of Oregon and Washin 1868 is still as near to the truth as I can attain, and is generally nized as a close approximation.

Mr. Samuel C. Mills, agent of Wells, Fargo & Co., at Portland, me with the following table of shipments for 1869:

January	$
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	
Total	2,

The following amounts represent the bullion shipment of Messrs & Tilton during 1869:

January	$5
February	
March	1
April	2
May	5
June	5
July	2
August	5
September	1
October	5
November	2
December	4
Total	41

Total, Wells, Fargo & Company	$2,55
Total, Ladd & Tilton	41
Private hands (Mr. Mills's estimate)	
Total	2,97

Ir. Mills remarks: It is impossible for me to say what proportion of
above belongs exclusively to this State, as Idaho, Montana, and
tish Columbia bullion reaches this city. Possibly one-half of the
ve amount belongs to Oregon.

o this I would remark that Mr. Mills's estimate only covers the ship-
its from Portland, whereas one principal placer district (that of Jose-
ie and Jackson Counties) probably ships its bullion overland to Sac-
ento and San Francisco. On the whole, therefore, I feel justified in
ing the production of Oregon and Washington at $3,000,000, a de-
se of $1,000,000 as compared with 1868.

CHAPTER XXVII.

THE GEOLOGY OF OREGON.*

he public expenditures of Oregon have thus far been conducted on
ale of economy too stringent to allow any expectation of such a lux-
as a State geological survey. A few brief notices of the geology of
Columbia basin, published in connection with railroad surveys, give
rly all that is accessible to the public of the geological record of that
ensive region. And yet the country is rich in geological material,
ning a field whose harvests are destined to be better known. The
ient Columbia River flowed through and from regions covered to an
raordinary extent with vast bodies of fresh water. No other water-
d of like extent has so worn down the channels of its streams as to
e drained off nearly the whole of its lake system; while through
now dry beds of those ancient lakes existing streams have still
ther excavated, until the whole is laid bare and open to the researches
the curious.

n entering the Columbia from the ocean, the facts that give the key
its geology stand out bold and clear in the outline of its extended
idscape. Two groups of mountains are in sight, each of which, in
rn, once formed a formidable barrier to the passage of that river to
e sea. On our right and left, as we enter, we see one of these groups
the subdued highlands that here represent the northern extension of
e Coast Range. Further on, one hundred and fifty miles eastward, we
e the other group in the more elevated, snow-capped summits of the
ascade Mountains. How like two vast tidal waves these two ranges
f mountains seem, as if rolled inland from the great Pacific, and petri-
ed in their progress into a rocky skeleton for a new land. And such,
n fact, they became. They bear now upon their elevated table lands
he records of the ages they spent beneath the waters of the ocean; the
ecords of the time and the manner of their emergence from the waters
over, often with alternating slope and terrace, their sides; while the
leep depressions between them contain like evidence that they once
held the inland seas in which, for a long period thereafter, were depos-
ited the remains of marine plants and animals of that period. The cor-
responding depressions east of the Cascade range, shut off from all ac-
cess to the ocean, soon lost the saltness of their waters, and therefore
only contain the record of fresh-water life.

These wrinklings or flexures of the earth's crust which folded its
rocky masses into mountain ranges, were not the only application of the

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*This article, by Rev. T. Condon, of Dalles City, was published in the Overland Monthly.

working forces of that age. There occurred, also, a general elevation of the whole of the now western slope of the continent, giving greater descent and consequent wearing force to its streams; and, as a result, the rapid wearing of their channels deeper, until many of its lakes were drained off. Now, as these streams have never since that time ceased to flow, and as the lakes into which they flowed, or from which they sprung, never, as long as they remained such, ceased to deposit, in the sediment of their floods, the history of the life-struggle upon their shores, or in their waters, the resulting records of these natural archives must have continued in uninterrupted series.

If this brief introduction be at all true to the facts of the case, then two plain and important truths force themselves upon us: One, that the emergence of its mountain ranges from the bed of the ocean forms a natural epoch in the geology of Oregon. The other, that an uninterrupted series of chapters in its record of the past is found in the now elevated sediment of its former inland seas and lakes.

Let us endeavor to get hold of the thread of this record at the point where it touches upon our own, and trace it backward into the distant past, as far as we may, unbroken. But, before consulting the earth itself for the facts that tell of past changes, and of the forms of life that existed long ago, a single Indian tradition, founded upon a belief among the Indians of the Lower Columbia of recent changes in the levels of that river, will not be uninteresting—perhaps not uninstructive. The legend states that formerly the Columbia River was navigable for canoes from the Chinook villages at its mouth to the Dalles, where a perpendicular fall of twelve or fifteen times the height of a tall man arrested even the ascent of the salmon, and compelled the Indians of the interior to journey to the Dalles for their fish, to trade for which they brought dried buffalo meat and buffalo robes.

The legend further states that a massive natural bridge then spanned the river at the present Cascades. That this state of things was suddenly brought to a close by a quarrel between Mount Hood and Mount St. Helen's, during which they belched forth fire and smoke at each other, and cast heavy rocks, with such noise and quakings of the earth as to shake down the bridge. That the ruins of the bridge form the present Cascades, having also dammed up the water above so much as to take away almost all of the upper fall at the Dalles, and so permit the salmon to pass over that fall and away into the interior, which they have continued to do ever since. Such is the Indian legend.

The gold hunter takes a pan of dirt, shakes it thoroughly in water till he sees the gold, if there be any. A similar process may enable the geologist to find some grains of truth in this Indian tradition. The legend associates the change with a quarrel among the mountains, during which they belched forth fire and smoke, and cast heavy stones. This does not need even translation to enable us to see in it a volcanic eruption—a supposition the more probable from the fact that both the mountains named have been seen by white men in volcanic action. The casting into the bed of the river of that ancient natural bridge we may believe to have had a partial foundation in fact—the fact of an extensive mountain land-slide, occurring during that volcanic action, and being precipitated into the bed of the river. The damming up of the waters above this slide would necessarily follow, and also a rapid or fall at the site of the slide. Some facts in the present state of the river, too, give an air of almost historic record to that wild legend: 1st. The river above the present Cascades is deep and slow of current. 2d. There are buried forests for miles along both banks, in places where local slides annot be supposed. 3d. There is now a glacier-like, lateral pressure gainst the railroad at the Cascades, so powerful that the road is con- inually thrown out of line toward the river, needing frequent re-adjust- ient. And, 4th. There are many evidences in the surrounding moun- ains of recent volcanic action there. So there may have been some ruth at the foundation of that Indian legend.

Let us return to the geological record. We were to take up the thread f that record at the point where it touched our own—the human. But here do we find the last foot-mark of the human record from which we are agreed to take our start? On the island of Guadaloupe the last uman foot-mark in the dim receding distance of the past is found im- edded in the solid lime-rock of the sea-shore; in Florida it is found closed in an ancient coral reef so remote from the sea-shore as to have equired a long period of growth in the land since it was impressed here; in Switzerland the remotest traces of human life are lost among he ruins of the wonderful and ancient "Lake Dwellings" of that won- erful country; in Belgium and England they are found incased in the talagmites of ancient cave dwellings; in France, buried among the ravel-beds of the valley of the Somme, in the form of rude stone im- lements of industry; upon the banks of the Mississippi, buried under ypress forests of untold ages; and in California, where that world-re- owned Calaveras skull was found, startling the world with a story of ntiquity beyond them all. When we turn from such a list to Oregon's ecord, and ask, where does the geological record of this State place he remotest foot-mark of human life? we are constrained to admit that pon this question of human antiquity Oregon's geology furnishes, as et, but little light. This may be, in part, owing to the few extensive xcavations of public works here. In some instances, too, where fossil ones were found, much care may not have been exercised in search of uman remains. In most of the instances of such discovery, however, t was otherwise; for the greatest care and diligence were used to de- ect the least sign of former human life.

Nothing has yet come to light in the geology of Oregon to show that he record of human life here reaches any further back into the past han would be indicated by bones and implements buried a few feet in urface soil. Some pieces of rude sculpture, representing birds, beasts, nd men, worked in a soft volcanic tufa, were found some years since, n Seauvie's Island, buried in surface soil, interesting in themselves, as ude works of art—perhaps, intended as idols—but throwing no light n the question of human antiquity. Stone implements are found in bundance along the Columbia River, often several feet below the sur- ace. Some of these are elaborately finished, intended for uses of which ving Indians are entirely ignorant; but none of these stone implements, ot even the rudest, have ever been found here, across that chasm that eparates, as yet, in our geological record, the human period from that hich is found next beyond, *i. e.*, the period of the extinct elephant.

A deeply interesting portion of the geological record of Oregon occurs mbedded in those sands, clays, and washed gravel-beds that mark the osition and outline of former lakes and streams, whose waters have ong since drained off, to return as such no more, leaving the long record f the varied forms of life that once struggled upon their shores or ported in their waters.

In the winter of 1865 a freshet, caused by the sudden melting of snows nd a warm rain-storm, occurred throughout Central Oregon. So violent re the floods that, in several places, within twenty miles of the Dalles, w ravines were opened through the country, laying bare beds of stratified clay, sands, and washed gravels, twenty to thirty feet below even the beds of the older ravines, extending, in some instances, to over a mile in length, and excavating to a width of a hundred feet or more.

That these excavations would lay open to the light fossil remains was to be expected. Search was made, and eight elephant tusks were found, of which five were so far decayed that, on exposure to the air, they crumbled to pieces; the remaining three have been preserved, and are now in good condition, though not entire. One of these, a part of a large tusk, is entire for about five feet of its length. It measures twenty-four and a half inches in circumference at the larger end, and twenty-two and a quarter inches at the smaller one, and belonged to the middle portion of the tusk. Another one, nearly all of which is preserved, though broken into four pieces, measures about seven feet in length, and is eighteen inches in circumference near the socket. In both these specimens the ivory structure is finely marked.

Other bones of the elephant were found in these excavations; among them a well preserved hip bone, the socket of which measures nineteen and a half inches round its rim. Several other bones, of less geological value, yet making in all a handsome collection, were thus obtained. Four well preserved teeth of the elephant were also found in these excavations. In the same beds were found other bones than those of the elephant. One of these is worth mentioning: part of the skull of an extinct member of the *Bos* family, perhaps the *Bos latifrons;* for a line drawn across the bony forehead measures eighteen inches, which is a trifle more than that of the largest of that species in the British Museum. A radius of an elk, entire when found, yet so fragile that it is now broken, was also discovered, with other bones, making the opening of a chapter of Oregon's early history, unlooked for in this region, yet not unappreciated.

As yet, no trace of human bones or implements has been found in these excavations; a negative statement, it is true, that amounts to but little as an argument against the existence, during the elephant period, of human beings on these shores. And yet, for a negative argument, it amounts to more than would appear in its first statement; for the vicinity was certainly a pleasant one for human habitations. The waters that covered these bones with sand and gravel stood two or three hundred feet above the present level of the Columbia River, and retained that level for a long time. A broad, beautiful lake extended westward and northward over the present city of The Dalles, and made the sheltered indentations among the low line of hills to the eastward a pleasant shore to inhabit. Into these indentations mountain streams washed the sediment that now covers the bones we find.

The objection to the force of these remarks, that those ravines are too narrow to lay bare but a very small part of the record, finds in a knowledge of the locality itself an answer; for these were ravines of ravines, into which the whole surface drained, and toward which all things movable by flood or wind tended. A careful search for some trace of human life in these excavations resulted in no discovery that would associate man with these early inhabitants of the lake shores of the interior of Oregon.

Three years ago some men attempted to dig a well fifteen miles from the Snake branch of the Columbia. They reached a depth of sixty-eight feet without finding water, and at this depth found, among washed gravel, a somewhat water-worn fragment of a bone. On examination, it proved to be the lower end of the radius of a horse. What a record comes to the light with this fragment of a bone! Sixty-eight feet from the surface, in a country nearly level for thirty miles or more. Sixty-ght feet of washed gravel, and kindred materials, showing a continued posit of a body of fresh water that could result from no other cause ıan a lake extension of the Snake River, at a much higher level than s present one. Sixty-eight feet of this filling in and extending for iles, thirty miles in one direction, and not less than this in others. his is surely an extended record of the past; and suspended, wonder-lly, yet reliably, upon a small fragment of a bone; for bone it certainly , and horse it as certainly was. Other localities than those named have ntributed their share of facts in this wonderful record. A large tusk as found in Polk County, a fine specimen of part of the lower jaw, with s two teeth broken; yet all these, and plainly elephantine, were dug om a mill-race at Dayton. Three teeth of the same kind were dug from mill-race on the Callapooya, near Albany; another, from Oak Creek, ar the same place. Several fine teeth were dug from a mining claim Cañon City, one of which, a large one and well preserved, is now in fe hands. The materials for the history of the elephant period are oundant in Oregon, with an almost certainty of large increase in future cavations.

Other animals than those named will doubtless yet be found repre-nted in those clays and sands and washed gravels, with the remains of e extinct elephant; yet those already discovered make an interesting oup. A few specimens of the woods of that period were also brought light, among them some well-preserved pieces of birch wood and a few nes of the larch.

The connecting link between our modern human period and that of the xtinct elephant, as before stated, is not yet found in Oregon. In other untries this has been found; for the teeth of the elephant and the imple-ents of stone, that speak of human industry, have been found together the same deposit; and therefore the elephant period was at once intro-ced in our sketch after the human period without questioning whether e had not thus dropped the promised thread of our record. The connec-on between the elephant period and that next beyond or older is not so lain; for that older record was closed in violence—in great outflow of olcanic floods and other kindred disturbing forces of the earth.

Animal remains in Oregon, older than those of the extinct elephant, re no longer found in clays, sands, and gravels, but in the argillaceous cks, sandstones, and conglomerates into which those were changed—ony remains still, and truly yet no longer bone, but rock. In these rocks e find opening to us the more recent chapters in the records of Oregon's rtiary rocks—records full of interest and beauty. In the period of hich these last tell us, the great interior of the country east of the Cas-de Mountains was interspersed with vast bodies of fresh water filled ith life and herb and tree, of insect and beast and bird; and the re-ains of these are preserved with marvelous truth and beauty, making e fragments of rock that contain them often gems of their kind—mute d blind yet truthful historians of an age long, long since passed away.

If the question be asked, why are the fossil remains of the elephant eriod in loose sands and clays, while the remains of the next period be-ond are found in like beds, but changed into sandstones and argillaceous ck? and we look around carefully for an answer to this question, we hall find that the facts that now separate the one period from the other peak plainly of a time of the escape of great heat and heated va-ors, loaded with mineral substances from the interior of the earth, and so of vast and frequent and continued volcanic overflows. How long at period of violence lasted, and how extensively it destroyed old things d built up new, are questions to be answered through future research.

That during that period all life was cut off from the earth, or even from this continent, is not to be believed; for, while it was a time of violent change and disturbance along the lines of our two principal ranges of mountains, a time of comparative quiet may have existed on the other slope of the continent, and life of plant and animal may have gone on in their accustomed round of growth and death. But here, in what is now Oregon, a broad and deep chasm in the history of life was brought upon the lands and upon the waters, separating the life-record on this side, which we have designated as that of the extinct elephant period, from that which existed beyond.

We have thus briefly skimmed over the surface geology of Oregon, treating our subject under the two divisions of, first, the human period; and second, the period of the extinct elephant. Briefly as the subject is sketched, it covers the records of a length of time difficult to realize; and yet our inquiries have only reached the threshold of the subject.

CHAPTER XXVIII.

THE GOLD FIELDS OF OREGON.

The gold fields of Oregon cluster around its mountain ranges, and may accordingly be designated by the names of its principal chains of mountains, as that of the Coast range, the Cascade Range gold region, the Blue Mountains gold field; those of the three cross-ranges of mountains, in Southwestern Oregon, known as the Siskiyou Mountains, the Umpqua Mountains, and the Calapooya Mountains, and those of the Snow and Puebla Mountains, in Southeastern Oregon.

The gold of the Coast range has only been found in paying quantities in the sands of the sea beach, from which it is washed at low tide. These beach diggings extend for hundreds of miles, with gold enough yet left in them to pay moderate returns for ordinary labor; and with a record running back over a period of twelve or fifteen years, whose statements may be divided into the "reasonable," the "marvellous," and the "fabulous;" and the numbers corresponding to each successive stage be stated at $12 to $15 per day to the hand, $50 to $100, and $800 to $1,000, per day—the last figures, doubtless, seldom found. The gold of the beach is found in heavy, black sand, apparently either brought down from the interior by the rivers of Southern Oregon, which come from a gold-bearing region, and distributed along the beach by the waves of the ocean, or else derived from broken-up ledges of gold-bearing rock near where it is found—the latter supposition seeming to find confirmation in the fact, that the best diggings (not only, but the only ones that have paid at all) are either around those capes and sunken ledges of rock that mark the extension seaward of the cross-ranges of mountains, the Siskiyou, the Umpqua, and the Calapooya, or else places where spurs of the Coast range itself come down to the sea. We find accordingly around—first, the seaward extension of the Siskiyou Mountains, at Point St. George, near Crescent City, extensive beach diggings; second, the extension, seaward, of the Umpqua Mountains, marked by a ledge of rocks running out four miles into the ocean, and only lost in the increasing depth, which is, too, surrounded by important beach diggings; third, from Cape Perpetua, several miles northward, marking the extension of the cross-range of the Calapooya Mountains—extensive beach diggings, still worked with paying results. At or near one of these points have been found the principal gold diggings of the beach, in every instance not connected with these points in which gold een found, the other class of facts were present, viz: the extension to the sea of some spur of the Coast range.

e inquiry naturally arises: Did the storm-surf disengage the gold these sunken ledges of rocks, these heads of gold-bearing moun- here plunging into the sea? Or did the rivers bring it from the or—the waves only distributing it along the beach in the direction ich prevailing winter storms would drive it—sunken ledges of rock ding across its path, arresting and holding it in their eddies?

rvellous stories are told of the wealth taken in former years from of these diggings. They are still worked, in three or four places, paying results. They extend from the California line to the Straits ca, but the principal ones are those named.

other gold field exists in Oregon, among the slopes of the Cascade . The Willamette Valley, which separates the Coast Mountains the Cascade Mountains, is part of a vast trough, extending, in its al features, from Puget Sound to the Bay of San Francisco, which is, Oregon portion, so filled in by tertiary and post-tertiary deposits that der rocks are, for the most part, buried far from sight. It is only cending the slopes of the Coast range, on its western margin, or of the Cascades on its eastern, that older rocks appear. All the ms that fall from the western slopes of the Cascade range contain or less of gold in their bars. The Clackamas, the Molalla, the am, the Calapooya, and the forks of the Willamette, have all been l to contain gold; only that of the Santiam has been worked.

ere is that in the gold of the Santiam which invests it with peculiar est to the mineralogist. It often presents the most beautiful sys- of lace-work, in gold threads, and semi-crystal forms of great sym- and beauty. A beautiful cabinet of these specimens may be seen lem, in the office of the company owning the Santiam mines. The am mines are not now worked, though they once awakened a good of interest. It is a curious fact that little or no gold has been found e streams of the eastern water-shed of the Cascade Mountains, oppo- he Willamette Valley, while those of the western slope so uni- y show its presence. It looks a little as if the fractures of the from which its floods of trap escaped were nearest the eastern and buried its older rocks on that side to a greater depth than on ther. The other volcanic materials, ash and pumice, would most ally, aided by prevailing western winds, drift in the same direction.

other gold field exists in Oregon, among the ridges and slopes of lue Mountains.

the region between the Cascade range and the outlying spurs of lue Mountains, the older sedimentary rocks are, for the most part, ed by trap and tufa; the trap varying in thickness from hundreds t, as seen at any of the crossings of the Des Chutes, to a thin cap- on the hills, sixty miles farther east; the tufa, as stratified sedi- of ancient lake beds, extending east and southeast over vast —its materials varying from fine volcanic ash to coarse masses of ce and obsidian. Traveling eastward, the trap is found at its, rently, greatest thickness in the trough of the Des Chutes, where an count as many as thirty distinct overflows, varying in thickness ten to twenty-five feet, and covering entirely from sight, even in leepest cañons, the older sedimentary rocks. Fifteen or twenty further east one gets a glimpse of the sedimentary rocks in the bed of Trout Creek, though yet covered by seventy-five or eighty feet of trap; twenty miles still further east the trap has thinned out to only a capping on the hills, while the varied strata of the tertiaries are in full view on every side in the region of the Currant Creek and the John Day's River. The lowest members of this tertiary series of Currant Creek are richly stored with the most beautiful specimens of fossil botany in the country. This order of succession of the rocks, as we travel eastward, is the same whether we travel farther south along the valley of Crooked River, or that of the John Day's, which, in its upper portion, also runs east and west, or in an intermediate line by Antelope Valley and the Cañon City road. But this series reaches the largest number of members along the line of the Crooked River Valley, for on reaching the forks of that stream, for the first time on our journey, we come to abundant and beautiful marine fossils.

Among these marine fossils there is one in so great abundance as to characterize the rock—a beautiful *Trigonia*, resembling *T. evansii*, of the California survey. *Ammonites*, *Turillites*, and other beautiful forms abound. I am the more particular to notice this outcrop of marine fossils, for here are found the first indications of gold in our approach to the Blue Mountains in this line of travel, and these indications increase from that place till we reach paying rock, at Cañon City, Willow Creek, Mormon Basin, and a score of other mining camps of the Blue Mountain region. A few miles still further eastward, from this outcrop of trigonia rock, other and apparently older marine rocks come to the surface; among these a limestone, containing *Rhynconella*, *Cyrtoceras*, and other marine shells, in the greatest perfection and abundance. The eastern slopes of the Blue Mountains have, too, their marine rocks; among these a dark blue limestone, with a small *Productus* in great abundance through it, is often met. These marine rocks lie against the outlying spurs of the Blue Mountains on the southwest, south and east, as an apparently ancient shore-line around an island, while the wide extent of lower country south, to the California line, is covered with volcanic materials, mostly as stratified tufas, in which masses of pumice and obsidian abound.

It was stated above that the same succession of rocks was encountered in traveling eastward along the line of the valley of the upper waters of the John Day's; one considerable exceptional mass of rock occurs in this line of travel, at about sixty or seventy miles east of the Des Chutes. It stands as a sort of island of slate-rock, without any appearance of fossil remains, surrounded on every side by more recent and plainly eocene tertiary rocks. The slates are traversed by veins of quartz, in which are traces of gold. Some work was done here a few years since in crushing rock, but without paying results. An abandoned arrastra may still be seen in a valley that opens into Currant Creek, near the Cañon City road, built to crush this rock. Dikes of trap are near. The strata are all very much disturbed around this older slate, but it is only an isolated spot of gold-rock, with no apparent connection with the mass of its kind further to the east. But while gold is thinly distributed here, fossil remains are not. The slate itself has no trace of organic life, but an ocean of tertiary surrounds it, and in this tertiary fossil remains are beautiful and abundant. A broad belt of this tertiary extends from the valley of the Crooked River, north across the line of the John Day's, and on toward the Columbia River, whose lowest member, in some localities, abounds in fossil bones plainly eocene, and in a portion of that same member at Bridge Creek, schistose rock occurs full of vegetable forms, some of whose leaves measure from twenty-five to thirty hes across, and these arborescent, too. This whole central region of egon, though now apparently poor in gold, is certainly rich in geol-y.

The country east of the Blue Mountains, comprising a part of Grant, d the whole of Baker and Union Counties, is described at some length the succeeding pages.

THE SNOW MOUNTAINS AND PUEBLA MOUNTAINS.

These mountains, extending into the southeastern corner of Oregon m Nevada, are, to some extent, gold-bearing; silver and copper ores e also found there, with what promise of future value remains yet to ascertained. A vast lake depression separates these from the Blue ountains, with no marked feature of interest to the mineralogist.

THE GOLD FIELDS OF SOUTHWESTERN OREGON.

The Siskiyou, Umpqua, and Calapooia Mountains—three cross-ranges nning from the Cascade range to the ocean—are gold-bearing, and eir mines are still worked to some extent. During the years 1852, 1853, d 1854, these mines were very productive; they are still worked, but inly by Chinese labor.

I shall proceed to notice in brief the principal mining counties of the ate. For the foregoing general remarks upon its gold fields I have to ank Rev. T. Condon, of Dalles City, a geologist whose enthusiasm d perseverance have made him intimately acquainted with many parts his adopted State.

In the following description I pass over several counties in which gold d silver occur, because there has been so little attention paid to min-g in those localities, or it was impossible for me to obtain enough stworthy information to supply a separate account of each. The unties thus passed by are Douglas, Lane, Linn, Marion, and Clack-as, along the west side of the Cascade range, and between it and the ast range. Gold has been found more or less in all these counties; t the superior attractions offered by agriculture in the fertile Umpqua lley in the first-named county, and the magnificent valley of the illamette, unequaled in the world, which includes the rest, have drawn ay, to some extent, the attention and energies of the inhabitants. ouglas County, which adjoins Jackson and Josephine on the north, is, wever, not without productive mining ground, like that which has ade its southern neighbors celebrated. Coffee Creek, Low Creek, the iddle Fork of the Umpqua, and Myrtle Creek, all in this county, have elded handsomely. New diggings were discovered during the past ar on the latter stream, and were reported to yield $10 to $15 daily r man. Their area is probably limited. There are also some promising artz veins in the Bohemian district, in Lane County, about fifty miles m Eugene City. The newspapers report silver as well as gold from is district. The Excelsior lode, owned by Messrs. Knott and Ladd, is have machinery put on it. Other lodes, less developed, promise well. t the time of my passage through the country most of the miners, who e also farmers, were harvesting their grain in the valley.

The mines of Santiam district have been the scene of intense activity d excitement. A few specimens of quartz from this locality attracted ach attention on account of their beauty and value. The wire-gold of ntiam is celebrated among amateur collectors of minerals. But the ning operations were a total failure. Thousands of dollars were expended in opening a road to the head-waters of the Santiam; building dwellings, a saw-mill, and a quartz-mill, and developing claims. The locations, buildings, and other property are now utterly abandoned, and the district is deserted.

In Umatilla and other counties along the Columbia, there is some bar-mining; but these operations are scattered and fluctuating, and I have been unable to obtain precise information concerning them.

Oregon is destined to become the seat of a wide-spread and productive mining industry in the precious metals. Her wealth in this respect has been explored to a comparatively small extent, but in so many different places as to indicate a vast area of territory, which will be available in the future. The remarkable facilities afforded by the State, by reason of her fertile soil and abundant coal, iron, and water-power, for agriculture and manufactures, will secure to mining the beneficent support of these branches of activity, and the farmer and manufacturer, in return, will find a needed stimulus and reward in the presence of mining communities at their doors.

CHAPTER XXIX.

JACKSON COUNTY.

I am indebted for much valuable information concerning this county to Mr. Silas J. Day, of Jacksonville, whose character and long acquaintance with the neighborhood give ground for confidence in the correctness of his statements, many of which are also confirmed by my personal observation.

The population of the county is about six thousand six hundred, of whom six hundred are Chinese, principally engaged in mining. The number of white miners, according to the books of the county assessor, is five hundred. The latter receive, when hired, from $2 50 to $3 coin per day. The wages of a Chinese laborer are $1 25 to $1 50 per day, or $35 per month. The following is a brief account of the principal mining districts in the county:

Jacksonville district, including both forks of Jackson Creek and its tributaries, was organized in 1852. The mines hitherto worked have been placers, with some coarse gold.

Applegate Creek, ten miles in a southerly direction from Jacksonville, is a considerable stream, on which a saw-mill has been erected. It is a tributary of Rogue River. The district of this name was organized in 1853. The mining operations on Applegate Creek have been quite extensive. The gold is found mainly on the "bars" of the creek, which for a distance of four miles were very rich. They are now principally worked by Chinese. Water is obtained from a large ditch brought from the creek four miles above the bars, and now owned by Kasper Kubli.

Sterlingville district, about eight miles due south from Jacksonville, was organized in 1854. This has been, and is still, a thriving mining camp. The gold in the placers is coarse. The supply of water, however, is limited, as there is no ditch in the district which taps any considerable stream.

Bunkum district, on the other hand, a southern extension of Sterlingville district, has an abundant supply of water during most of the year, brought in three ditches from the North Fork of Applegate Creek.

Foot's Creek district was organized in 1853. The stream from which takes its name is a tributary of Rogue River, situated about fifteen les northwest from Jacksonville. The mines are coarse gold diggings.

Evans's Creek and Pleasant Creek districts are contiguous to each ier, about ten miles north of Foot's Creek. The coarse gold diggings these districts are worked principally by the hydraulic process, for iich the necessary supply of water is furnished by the streams named abundance during the rainy season. Both these districts were organd in 1856.

Forty-nine diggings, eight miles southeast from Jacksonville; organd in 1858. The gold is inferior in quality, and worth only about $12 r ounce. Water is supplied by a ditch from Anderson and Wagner eeks.

The mining laws of all these districts are copied from those of Yreka, California. The tax on foreign miners (by which only the Chinese are derstood) is $16 annually per capita. There is also an annual poll-tax $5 on all mulattoes, Chinamen, and negroes.

The first discovery of gold in Jackson County is said to have been de in the autumn of 1852, by James Cluggage, on Rich Gulch, a tribary of Jackson Creek. Both in the gulch and in the creek large nugts were, in the earlier days of the mining industry of this neighborod, frequently found. One piece of solid gold, worth $900, was taken m the latter stream, and many were obtained ranging in value from 0 to $40, and up to $100. These discoveries led to the development a considerable mining industry, in which, however, no great amount capital was invested. The claims in the county are, with the excepn of the bars and a few quartz claims, mentioned below, generally cer and gravel diggings. The heavy wash gravel ranges from two to elve and even twenty feet in thickness, and contains a large amount stones, and even rocks of considerable size. This is especially the se on Jackson Creek. The bed rock is slate or granite—the former edominating. Water is supplied principally by the rains of the wet son, which swell the local streams. There are few mining ditches in e county, and none of great magnitude, the length being generally m one to four miles, and in no case exceeding the latter figure. The nes are therefore directly dependent upon the duration of the season rains. This lasts usually from December 15 to June 1. The mining son for the year ending June 30, 1869, was, however, here, as ewhere, a very short one, owing to the extreme dryness of the winter. e season opened about the 10th of January, and was over by the ddle of May. When I visited the county, early in August, nothing s doing except by some of the Chinese, who were painfully overhaulg the dirt heaps and carrying the earth to water. The average annual oduct of Jackson County in gold dust for the last five years has been, cording to good authority, $210,000. I estimate the product for the ar ending June 30, 1869, in spite of the brevity of the season, at 00,000, since the patient labor of the Chinese, of whom there are a siderable number working for themselves, has made up the deficiency the season. They have produced not less than $75,000 during the ar referred to. The product for the calendar year 1869 is practically e same as I have given, since the period of active operations fell wholly thin 1869.

Some very rich quartz ledges have been discovered in this county, d I do not doubt that this, like so many other placer-mining regions, l eventually become the scene of extended deep-mining operations. quartz veins, however, so far as I could learn, have been worked in kson County with capital, perseverance, and judgment adequate to fully prove their values, though in several instances large profits have been realized from operations near the surface.

One of these instances is presented by the celebrated Gold Hill vein, situated ten miles northwest of Jacksonville, and discovered in January, 1859. The ore is white, almost transparent quartz, and, in the pocket first exposed, was highly charged with free gold. Some rock taken from the ledge was so knit together with threads and masses of gold that when broken the pieces would not separate. The vein was worked rudely for a year, and the ore crushed principally in an arrastra. The sum of $400,000 was thus extracted, besides a large amount of extremely valuable specimens, one of which was presented by Maury and Davis, merchants of Jacksonville, to the Washington Monument, and now, I am informed, occupies a place in that structure. But the pocket became exhausted; subsequent operations failed to find paying rock, and the work has been suspended for some years. The property is now owned by a few shareholders, who intend to resume mining at some future time.

The Fowler lode, at Steamboat City, twenty miles from Jacksonville, is also at present lying idle. This ledge was very rich near the surface, where the rock was considerably disintegrated. The contents of a rich chimney or pocket were extracted, and crushed in arrastras run with horse-power. Major J. T. Glenn, one of the owners, says $350,000 were taken out.

Arrastras were erected at a ledge on Thompson's Creek, a tributary of Applegate, to work the ore extracted, but the rock did not pay, and it was finally abandoned. The Shively ledge, on a tributary of Jackson Creek, has had a similar history.

At present there is but one quartz vein worked in the county. It is being developed by a few men as a prospecting scheme. They carry the quartz about a mile, to the Occidental mill, where they have already had about 100 tons treated, realizing about $1,000, or $10 per ton.

There are three quartz mills in the county, all driven by steam. The Jewett mill, on the south side of Rogue River, was erected six years ago in connection with a ledge of the same name. It had eight stamps, and 32 horse-power. The investment was not profitable, professedly because the gold was too fine to be saved, and the mill is now a steam saw-mill.

A mill similar to the foregoing was put up seven years ago at the forks of Jackson Creek. It cost $8,000, and was intended for custom work, but did not pay, and is now owned by Hopkins & Co. as a saw-mill.

The Occidental mill, on the right fork of Jackson Creek, was built four years ago by a company at a cost of $10,000. It has ten stamps, and 40 horse-power, was made at the Miner's foundry, San Francisco, and has a daily crushing capacity of 20 tons. The machinery includes two rotary pans.

The cost of mining materials in this county is not excessive. Lumber is worth at the mill from $18 to $22 50 per thousand feet, according to quality; quicksilver, $1 per pound; blasting powder, 33 cents per pound. Freight is generally shipped from San Francisco to Crescent City, California, and hauled from there in wagons to Jacksonville, at a total expense, including commissions, incurance, &c., of about 5 cents per pound. This enhances the cost of machinery and of some supplies. As a general rule, Jackson County receives no freight overland from Portland or Sacramento.

There are several good salt springs in the county. One at the headwaters of Evans Creek has been worked with profit for several years past y Messrs. Brown and Fuller. The salt is said to be white and pure, nd commands a good price in the local market. Two beds of mineral oal have been discovered in the county. One on Evans Creek, about en miles from the salt-works, produces a superior coal, which is used by he blacksmiths of the county. It is comparatively free from shale, and is locally known as anthracite. The bed is owned by Mr. R. H. Dunlap, of Ashland. Large quantities of iron ore occur in many places throughout the county, on the surface of the ground. Some specimens from Big Bar, on Rogue River, were analyzed in San Francisco, and found to be quite pure. Cinnabar is reported, but not in paying quantity, from Missouri Gulch, a tributary of Jackson Creek.

CHAPTER XXX.

JOSEPHINE COUNTY.

This county is situated in the southwestern part of the State, and contains about two thousand five hundred square miles. It is bounded north by the Rogue River Mountains, separating it from Douglas County, east by Jackson County, south by California, and west by Curry County. There are about fifteen hundred inhabitants, and five or six thousand acres of land under cultivation. Kerbyville, Leland, Slate Creek, and Waldo are the principal towns. The condition of the placer mining in the county during the past year has been substantially the same as in Jackson County. Josephine suffers somewhat from lack of regular communications. It is perhaps on this account that I have failed to receive the detailed reports promised by letter from Sailor Diggings and other noted localities. The following description, furnished to a committee of the State Agricultural Society in 1869 by Dr. Watkins, a physician long resident in the county, may be relied upon.

Josephine County attracted attention as early as 1852, as a locality for placer gold-mining. The first mining of any importance was on Josephine Creek, which derived its name from a daughter of one of the miners, and afterward gave name to the county. In the spring of 1853 there was a great rush to the mines on Althouse Creek, which rises in the Siskiyou range, and runs in a northerly direction, uniting with other tributaries, forming Illinois River. The diggings on Althouse were very rich, the bed of the stream paying not only heavily but quite uniformly. At one time Adams & Co.'s books had a thousand names to obtain letters for in the different localities, where miners had previously resided. Sailor Diggings was then a famous locality; a ditch was dug some fifteen miles long at a cost of some $75,000 or $80,000 to bring water to the rich placers of this vicinity, and when fairly under way paid for itself the first year. It paid heavy dividends to its stockholders for ten or twelve years, and many parties who live sumptuously every day owe their fortune to their connection with the Sailor Diggings Ditch Company.

Sucker Creek, a tributary of Illinois River, a large turbulent mountain stream, was extensively mined from 1854 to 1860, but the diggings are deep, the boulders are large and unwieldy, the stream an unmanageable one, and, I think, never made an adequate return for the labor expended; but Sucker Creek has not yet had its day, and, with cheaper labor and better facilities, it will yet yield a golden harvest to the hand of adventure.

Cañon Creek, Illinois River, and Galice Creek, were mined during these years, and generally with an adequate return for labor expended.

Williams Creek, a tributary of Applegate Creek, has had for the last few years a hardy mining population, who have met with a moderate return. Josephine is a mining county, and has had all the vicissitudes of such a county. Her citizens leading a roving life, and having little to bind them to the soil, mostly left during the Indian war of 1855–'56. Her rich minerals brought back to her a renewed population, however, but the great Fraser River excitement nearly depopulated her, and now she is only the shadow of her former self. But her rich placers are far from being exhausted. There are rich veins of copper running into her hills. The most noticeable one, some eight or ten feet in thickness, is situated in the hills between Waldo and Althouse; but for some reason attempts to work it have failed, although it appears to be of great purity and inexhaustible in quantity. But the copper mines down Illinois River will yet make this locality famous; the copper is found in well defined lodes, and practically inexhaustible. The question is one of transportation.

Platter & Beach have been running a tunnel for the last three years through a heavy divide, to turn the waters of Althouse, so as entirely to drain the bed of Althouse Creek. Hanson & Co. have done the same at another point, and are now "striking it rich." These two operations have opened a district of great mineral wealth, which will awaken the old times in placer-gold mining on Althouse. The returns of the Malachi quartz lode have been very heavy; and it is reported that this property has been purchased by a San Francisco house, who are pursuing the enterprise with vigor.

The county is dependent for supplies upon a slow, laborious and costly transportation over the Coast range.

CHAPTER XXXI.

COOS COUNTY.

This county being situated west of the Coast range, and receiving much moisture from the Pacific Ocean, which bounds it on the west, is better adapted to grazing than most of the country in the interior. The surface is hilly and broken, with extensive forests, and not infrequently large and fertile prairies and valleys, covered with heavy growths of nutritious wild grass. The timber is fir, spruce, alder, oak, soft maple, and cedar. The white cedar is the best finishing lumber found on this coast, and is exported to California, the Sandwich Islands, and even China. All kinds of grain (except maize) and vegetables are adapted to this section. Coos Bay is the leading sea-port in Southern Oregon. Empire City, about four miles from its mouth, is the county seat. There is a number of steam saw-mills on the bay, doing a thriving business. The principal mineral wealth of the county thus far developed is found in its extensive coal fields, which have been worked more or less steadily for the last ten years. There are, however, rich gold deposits in the southern part of the county, and indications of silver, copper, and iron are reported. The Randolph claim is reported to have shown very rich discoveries, early in 1869, streaks of sand having been found paying forty to fifty dollars daily to the hand.

The Coos Bay coal deposit was examined during the year by Mr. Wil-

Ashburner, of San Francisco, to whom I am indebted for informa-
n the subject. It is composed of three seams, inclosed in sand-
, dipping toward the southwest at an angle of about fifteen degrees.
wo principal and lowest seams are each two feet and three inches
ickness, of uniform quality, and separated by an intercalated
m of sandstone four inches thick. The upper seam of coal, be-
being of inferior quality, is only one foot thick, and is not removed
e miners, but allowed to remain and support the roof, which is
nd easily sustained.

e coal produced from this mine is of the quality known as "brown
' of recent geological formation, and therefore distinct from the
ipal coal measures of the eastern States. It has a fine black color,
brilliant conchoidal fracture, is free from iron pyrites or sulphur, not
to spontaneous combustion, and burns without the disagreeable
so frequently accompanying coals of this nature, leaving but
ash.

e very superior quality of this coal for domestic purposes has been
iently demonstrated by an experience of many years in San Fran-
, where it is said to command a better price than any other coal of
oast; but how far it can be made available for industrial purposes
cean navigation can only be determined by actual experiment on a
scale.

is deposit, taken as a whole, appears very extensive and covers a
considerable area. There is well authenticated information of coal
found at least eighteen miles south of Coos Bay, though at too
a distance from the coast to be made available. The fact is inter-
g and important, as going to prove the extent and continuity of
asin in this direction. Over nearly or quite the whole of this
n the country is heavily wooded, so that detailed researches are
ssible upon the surface. The only means of defining the limits of
oal tract and obtaining a correct knowledge of its more important
gical features would be by boring, a labor involving time and ex-
, and which, under the circumstances, is quite unnecessary, for
rmation is very regular and apparently destitute of faults or dis-
ions, and the ravines and gulches which traverse the country have
made by erosion, and not by any deep-seated action which would
the regularity of the coal deposit. These features are extremely
able and important for the future working of the mines, rendering
inning of the coal far more economical than if the seams were
d and broken.

e distance from the wharf to the mouth of the Coos Bay Company's
is one mile. The loaded cars descend to the water's edge over a
ad of easy grade by force of gravity, and are returned to the mine
ules.

ch is the purity of this coal that it requires no assorting, but is
d directly on board ship as it issues from the mine, or else stored,
ting the arrival of a vessel.

e cost of delivering one ton of this coal in San Francisco is not far
seven dollars, and is composed of the following items of expense:

		Per cent.
g and delivering the coal on the cars in the mine	$1 00	14.3
or and exterior transportation	15	2.1
t to San Francisco	4 50	64.3
e in Coos Bay and across the bar at the mouth of harbor	1 00	14.3
es	35	5.0
	7 00	100.0

By an inspection of the above statement it will be perceived that freight and towage amount to nearly eighty per cent. of the total cost, and that none of the other expenses can be regarded as excessive, but are, on the contrary, very low as compared with other coal mines upon this coast. This is mainly owing to the remarkably favorable conditions in which this property is situated for economical working. The items of towage and freight to San Francisco will be probably lessened when a new tug, now in process of construction, shall have been completed. The cost of freight to San Francisco must always depend in a great measure upon the facilities afforded for entrance to and egress from the harbor, the rapidity with which vessels can be loaded, the average length of the voyage, and the risk of detention. By reducing these to a minimum, a reduction can be probably effected upon the present cost of freight. Assuming the thickness of the workable seams to be four feet six inches—which they are fully—and the loss from wastage to be twenty-five per cent., each acre would produce 5,000 tons of coal.

Congress has made a grant of land for a wagon road from tide-water on Coos River to Roseburg, in Douglas County, and a company has begun the work. This will enable Coos Bay to command the tract of the Umpqua and Rogue River Valleys.

CURRY COUNTY.

This is the most southwestern county of Oregon. It resembles in surface conformation, soil, timber, and climate, the foregoing county, which is adjacent to it. There is less rain during the winter west of the Coast range than between the Coast range and the Cascade Mountains.

At the mouths of the Coquille and Rogue Rivers are harbors that have been used by small vessels, to some extent. At Port Orford there is good anchorage, and a roadstead well protected, except from the southwest. This is the principal shipping port, and steamers frequently stop on their way up and down the coast. Coal, copper, silver, and gold are found at different places. Gold-mining has been found remunerative in many places, principally, however, along the coast just above the summer tide line, or where the sea has receded, in the sand. These mines are inexhaustible, as the high tides and seas of winter bring a fresh supply of sand mixed with dust, for the coming summer's work. The average returns from this kind of labor are, however, not believed to be very high. In my opinion this beach-gold is derived by abrasion from quartz lodes, brought down to the sea by the streams, and rolled back by the tide upon the shore, just as the sands of Port Said, the Mediterranean terminus of the Suez Canal, are found to be the deposit of the Nile. The copper mines and quartz ledges of the coast will be worked to advantage at some future day. Recent developments of quartz ledges are said to be very flattering. Rich gulch diggings are reported to have been discovered during the past year on Sixes Creek, in this county, higher up the stream than operations had ever been carried on before.

Besides the rivers named, there are several smaller streams putting into the ocean, in all of which, in the spring and fall, large quantities of the finest salmon may be easily caught. They are a staple article of food at home, and are already becoming an article of export, and the business of exporting them will largely increase as the art of preserving them fresh in cans is better understood. Cod and other fish are also caught with hook and line at Port Orford, and there are banks *near* the mouth of Rogue River where codfish may be caught. Much f the timbered country is easily cleared during the long, dry summers, nd thus the best of farms are made along the streams, even where here are no prairies. Bees have been imported, and do remarkably well, and the honey is better than that gathered on the large prairies in he interior.

There is a road from Crescent City, California, up the coast to the mouth of Umpqua River; also from Port Orford back into the Umpqua Valley. Another leads from tide-water on the Coquille River to Roseburg.

CHAPTER XXXII.

GRANT AND UNION COUNTIES.

Grant County is rectangular in form, included between the parallels 42 and 45 of north latitude, and the meridians 41 and 43 of west longitude. It is bounded, north by Umatilla County, east by Union and Baker Counties, south by the State of Nevada, and west by Wasco and Jackson Counties. Its area is not far from 14,000,000 acres. In the eastern and northeastern portions the country is broken by the Blue Mountains and their spurs; in the central and western parts, drained by the three forks of the John Day's River and their tributaries, numerous small valleys of great fertility are found, and the hills and table-lands, covered with bunch grass, afford a vast area of pasturage for stock-raising. Extensive grass prairies stretch southward to the boundary of Nevada, and are traversed by a chain of small lakes, connected by fresh-water streams, and supposed to be a part of a great internal, isolated lake system, which includes the Great Klamath Lake Valley, in the eastern portion of Jackson County, Sprague's River Valley, and the Humboldt basin in Nevada. The lakes of this chain in Grant County are Grass, Antelope, Christmas, Trout, Malheur, Harney, North, and Middle Lakes. The connection between these and other interior lakes is not fully established, and I think it doubtful. It seems to me quite as likely that the continuous basin or basins once existing have been separated into much smaller systems, each having its own independent water supply, and maintaining itself by a fluctuating equilibrium between the rain or snow-fall of the wet season, and the evaporation of the rest of the year. They abound in fish, especially bass and mountain trout, and afford to mining prospectors a much easier and cheaper method of obtaining provisions than the pack-saddle or the rifle. The country is accessible from the Columbia River by means of a good road from the Dalles to Cañon City, and the regular mail route from Umatilla to Boise, which passes through Umatilla and Baker Counties, along the borders of Grant. South of Cañon City a good military road leads to Boise. For the convenience of the settlers, and the more rapid development of this country, it would be well to send the through overland mail from Boise on alternate days, or weekly, by way of the Cañon City road, instead of keeping a daily mail on the Umatilla line. The government patronage would help to support two lines of communication, and the cost to the public would be no greater. The two routes are of equal length, and the same time could be made on both. As far as the pleasure of travel is concerned the road through Grant County is less dusty, and the scenery incomparably finer. There are no more picturesque views on the Continent than the panoramic display of the Cascade range seen from the heights above the Des Chutes, or the deep basaltic gorge of the latter river, or the wild, grotesque cañons of the John Day's, or the thickly wooded ranges of the Blue Mountains traversed by this road. At present there is an excellent stage and express line from the Dalles to Cañon City, but no regular communication beyond. I made my way from the latter place by bridle-paths across the Blue Mountains into the Powder River and Burnt River Valleys, visiting on the way a considerable number of mining camps, and satisfying myself, by personal observation, of the immense extent of territory in this obscurely known region, which will, hereafter, furnish a basis for extensive gulch and placer mining.

Our great continental interior may be roughly divided into the buffalo-grass country, the sage-brush country, and the bunch-grass country. To the third of these divisions belongs the eastern part of Oregon, between the Cascade and Blue ranges. The sage begins to predominate as the Nevada line is approached. Neither of these two, so far as I know, are found to any extent east of the Rocky Mountains, and the buffalo grass does not grow west of that chain. This explains the fact, of which I am assured by hunters and others, that no buffalo or buffalo bones have ever been found beyond these mountains.* But I return from this digression to a description of the mining fields of Grant County. In this connection I would gratefully acknowledge the courteous assistance furnished me by many citizens, and especially by Messrs. W. V. Rinehart and John L. Miller, of Cañon City.

Grant County is one of the principal seats of placer-mining in the State, and although it has of late, and especially during the past year, declined in importance, it will doubtless recover from this temporary depression. The principal mining districts are:

Dixie Creek, eighteen miles east of Cañon City, the county seat, organized in the summer of 1862. Its present population is 100 whites and 200 Chinese. The stream is worked for about five miles by sluice-washing, and yields fine scale gold, containing more than the usual proportion of silver. The fineness is about .860.

Elk district is situated thirty miles north of Cañon City, on the creek of the same name, a tributary of the John Day's River. Gold was discovered in this district in April, 1864, by a party in pursuit of Indian horse-thieves. During that summer it was prospected with favorable results by Mr. John L. Miller, of Cañon City, and others, and operations have been continued during successive seasons ever since. The bed-rock is said to be slate. The mode of working has been for the most part by drifting under the surface, in the auriferous stratum, and raising the dirt by windlass, water-wheel, or horse-whim. A few claims, however, are worked in the early part of the season, when the snow is melting, by stripping off the surface, fluming, and ground-sluicing. The largest nugget found on Elk Creek was worth $480. Deep Creek, in the same district, has produced one of 37 ounces, worth $629. A ditch, commenced in 1865 or 1866 by the Pioneer Company, and completed December, 1868, by other owners, brings water to the claims of its proprietors on Deep Creek, where hydraulic mining is conducted. It is eleven miles long, four miles being two feet wide at the bottom, and three on the top, and seven miles four feet on the bottom and about five on the top, with a depth, on the lower side, of sixteen inches. A large reservoir, on Deep Creek, was completed in 1869. The ditch cost $17,600, gold, and the reservoir about $1,500. Water failed very early this year, e run lasting only from May to July, and the product from the hydraulic aims is said to have been only $1,800.

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* This is not literally true. The Indian legend, mentioned in Chapter XXVII, is confirmed by the testimony of Mr. Clarence King's party, who have found the bones of the buffalo west of the Rocky Mountains.

The Middle Fork of the John Day's, at or just below the mouth of lk Creek, has been worked since July, 1865, and produced in the aggregate about $42,000. The gold is fine flour gold, and has, like that of lk Creek, about the same fineness as that of Dixie.

Elk district contains also numerous quartz lodes, but little work has een done on them beyond what is necessary to hold the locations, under he Oregon statute. The Gem of the Mountain, owned by Hugh McQuaid, claim 400 feet, deepest shaft 56 feet, has a vein averaging 4¼ eet, coursing northeast and southwest, dipping east, with a foot-wall of alcose slate. The quartz yields per ton, in arrastra, $26; by mill process, No. 6 screens, copper plates,) $14 26; gold, .691. The National has an riginal claim of 1,500 feet, shaft 27 feet, showing a vein of 22 inches verage width. The quartz yielded by mill process, (No. 7 screens,) $20 per ton; but prospects indicate that it should yield $50, especially along the foot-wall. The miners assert that the company is trying to "freeze out" some of its members, as, in spite of these favorable indications, the shaft is caved in and filled up, and no work has been done since December, 1865. The quartz-mill is located on the left bank of the Middle John Day's, opposite the mouth of Elk Creek. It contains two 4-stamp batteries; stamps, 500 pounds; drop, 8 to 12 inches; crushing capacity, 8 to 10 tons quartz per twenty-four hours; driven by steam, 25 horsepower; machinery bought at Portland; castings poor. A Knox pan, for amalgamation, is to be attached, to supplement the copper plates. The quartz is hauled from two to five miles to the mill.

A second ditch is in process of construction, about eight and a quarter miles long, two feet wide at the bottom, and three at top, by fifteen inches deep on lower side. It will bring water to the Elk Creek diggings, and is now about completed.

The population of the district, July 1, 1869, was 60 whites and 65 Chinamen. The product of gold for the season of 1869 will not exceed, according to my estimates, $16,000. Mr. John H. Blake, merchant, of Susanville, has purchased from August, 1865, to August, 1869, $80,000 f gold dust from this district. Wages have been in different years as ollows: In 1865, 1866, and 1867, for ground-sluicing and working on the iver claims, $5 per day to the hand; for drifting, $6 per day of eight ours; windlass-men, $5. Board, $9 to $10 per week. In 1868 and 869 the average wages were only $4 per day. The district is 12 miles quare.

Olive Creek district, organized in the spring of 1863, is in the Blue ountains, about 60 miles north by east from Cañon City, and near the ources of the North John Day's, Burnt, and Powder Rivers, the first of hich flows northeast to the Columbia; the two latter southeast to Snake iver. The quality of the gold obtained here is variable, being coarse nd fine, pure and impure, within a few miles on the same stream. Some f it is not worth $14 per ounce, while other dust, from localities within wo miles, will be worth $16. At the very source of the stream, in a ulch near the summit of the mountains, the gold is ragged, as if quartz ad been disintegrated from it, leaving it porous and spangled. This is oor in quality, the finest being found three miles below. The population of this district is 80 whites and 50 Chinese. The snow falls in winter 8 to 12 feet deep, and prevents active work. The season for mining from May to August, while the snow is melting. Supplies for this amp, as also for Elk and Granite, are chiefly brought from Umatilla, n the Columbia.

Granite Creek district is twelve miles north of Olive, and the gold is similar in character. This district was organized in the autumn of 1862. The present population is 40 whites and 200 Chinamen.

Burnt River district lies a little east of and between Olive and Granite. It was first worked in 1867. The present population is 80 whites—no Chinamen. The absence of the latter is proof that the mines are paying well. The whites seldom permit them to come into a new and rich district; and the working of placers by Chinamen may be taken as evidence that the deposits do not pay good wages to white labor. With its smaller population, Burnt River has yielded as much gold as any district in Grant County, except Cañon itself. The process employed is chiefly hydraulic mining. The gold is coarse and fine, mixed, of a peculiar dark greenish color, and heavy. It is worth $16 50 per ounce.

Cañon Creek district is doubtless the most important in the county. It surrounds Cañon City, the county seat, which has been a thriving town, and may yet recover its former prosperity. It is situated on the creek of the same name, several miles from its junction with the John Day's. At the time of my visit the dry season had permanently stopped nearly all the operations on the creek; but the vast extent of the placer and hydraulic mining in the bed and along the banks of the stream was evident enough in the numerous ditches, hydraulic pipes, sluices, wheels, and immense heaps of earth and gravel extending along the creek for miles. Five years ago the shipments from this place averaged $22,000 per week; they now barely reach $8,000 per week during the working season, which lasts from April to October, and perhaps $20,000 per month for the remainder of the year. The express charges on bullion to Portland are three and one-half per cent., which leads many merchants to patronize the United States mails. For this purpose the dust is put up in flat tin cases, to fit regulation packages envelopes, and sealed with solder. The full weight allowed by law is sent in a single package, and others are added until, if necessary, thousands of dollars are thus mailed at one shipment. Not infrequently two hundred and fifty ounces go in a single mail. Nearly all the gold of Grant County goes down the Columbia to Portland, and thence by sea to San Francisco. The shipments are mainly made by the merchants, to whom the miners pay or sell the dust. This explains the fact that shipments continue even in the winter, when no gold is actually produced. All the districts except Cañon and Dixie trade with Umatilla or Susanville; and hence the figures above given cover the product of these two districts. This would give about $300,000 as the present annual yield; but on the one hand, no account is taken of the sums carried away by private hands; and on the other hand, I do not think the very disastrous season of 1869 will equal this average estimate. The placer yield of all these districts has fallen off steadily for the last five years. It will revive again, partly by the return of old settlers, who have been prospecting elsewhere without finding anything better than they left behind; partly by the introduction of additional water facilities; partly by the use of Chinese labor and the estalishment of more reasonable rates for white labor; and partly by the development of a stable quartz-mining industry, the necessary basis for which is abundantly afforded.

The following ditches supply these claims:

	Capacity.
Miners', 20 miles long	700 inches.
Hillis, 11 miles long	800 inches.
Thompson, 4 miles long	600 inches.
Humboldt, 8 miles long	1,200 inches.
Lone Star, 4 miles long	500 inches.
Forlorn Hope, 4 miles long	500 inches.

The water is measured from a box set horizontally, through a vent 6 inches deep, with 6 inches head. The rates charged are 8 to 12 cents per inch, per day. Thirty inches is an average sluice-head; 75 to 150 inches is required for ground-sluicing, and 200 to 300 inches for hydraulic, where no sluices are used. Wages at Cañon City are $3 50 a day for most kind of mining. Pipers at hydraulics, and drifters in tunnels, receive from $4 to $6. Chinese miners, $1 75 to $2, without board; Chinese cooks, $8 to $10 per week, with board. Flour of home production commands $9 per barrel; the finest brands, $16. Oats, 1¼ cent per pound; wheat, 2½ cents; potatoes, 1½ to 2 cents; cabbages, 2½ to 3 cents. The cheapness of agricultural products arises from the fact that the troops and posts maintained by the government in this region during the Indian war stimulated a considerable farming industry, especially along the magnificently productive bottom-lands of the John Day's. The high prices paid for hay, oats, and other supplies, made this business very profitable; but the peace, and the consequent withdrawal of the troops, has caused a collapse. The farmers of the John Day's Valley cannot afford to ship their products to more populous regions, nor can they find an adequate market at home. Agriculture will therefore temporarily languish, until mining revives—an event which will be hastened, no doubt, by the present low prices.

With regard to general merchandise, the prices at Cañon City are about equivalent to those at Portland, with the freight added. This amounts to 4 or 4½ cents per pound. Board at hotels in Cañon City $7 to $8 per week. There are in the vicinity four saw-mills, where lumber can be had at $20 to $30 per thousand. Cord-wood is delivered at $6 to $7.

The great variation in the quality of the placer gold of this country is, I think, a special indication of its various origin. In other words, it should encourage the belief that numerous different quartz veins, cut by the deep ravines of the John Day's and its tributaries have furnished the gold now found in and along the streams. This belief is confirmed by discoveries already made; and it is strikingly illustrated in the works of the Prairie Diggings Mining Company, about five miles east of Cañon City.

The Prairie Diggings claims, as the name indicates, were originally gulch or placer mines upon the elevated rolling surface of one of the foot-hills east of Cañon Creek. The gulch is almost dry in summer. The circumstance that no gold occurred in it above a certain place, below which the diggings were rich, led to the discovery at that place of a large body of auriferous quartz crossing the gulch. This locality illustrates, in a striking manner, the formation of placer deposits from quartz lodes. The country-rock is dark slate, turning red on exposure. A belt of quartz and slate apparently 400 feet wide, coursing northeast and southwest, and dipping sixty degrees southeast, has been exposed by the erosion of the gulch. The channels of quartz are separated by slate, and have received different names as separate veins. Of these the Waterloo and I. X. L. are the most prominent. The width of 400 feet, above mentioned, is possibly illusory. In any case, it only refers to the distance between the extreme veins or channels of quartz on either edge of the group; and quite probably this appearance of width has been produced by a slide from the upper veins of a considerable section. If this were the case, the same series of rocks would be twice represented in the gulch, but the upper veins would be the true ones and would be found to continue in course to the northeast and southwest. This is indeed the fact. The Waterloo and I. X. L. are traced by outcrop on either side the gulch, and the masses be seem to be but a repetition of these. The exact width of the bel therefore matter of doubt. A shaft 30 feet deep on the Wate shows a vein of 11 feet inclosed in slate, and a pit of 10 feet on I. X. L. exposes a vein of 6 feet, also in slate. But the outcrops these and the other veins distributed through the gulch, afford an e mous quantity of decomposed auriferous material, which has only to dug up and wheeled into the mill. This was built in 1868, at the Vul Works, San Francisco, and is calculated for ten stamps, though only have been actually erected. Weight of stamps, 640 pounds, drop inches, 70 times per minute. Discharge, No. 2 Russia. Power, wa wheel 40 feet in diameter, 4 feet breast, supplied by a ditch f the hills above. The average capacity of such a battery, runn at this speed on ordinary quartz, should be about 7.8 tons daily. T mill crushes ten tons in twenty-four hours, and is even claimed have reduced 200 tons in a run of 12 days. The excess over general average is to be ascribed to the peculiarly friable nature of material. The average yield of considerable quantities milled, I beli to have been about $8 50 per ton. With the present almost nomi cost of extraction, and transportation only a few yards to the mill, water-power, and simple amalgamation, (battery-amalgamation, 20-f blanket-sluices, 20-foot copper-plated sluices, Knox pan for blan washings,) and the fineness of the gold obtained, (nearly .900, it said,) this property ought to pay handsomely, if the ore yields ove per ton. Actual figures of working results are withheld on accoun a pending litigation. This is itself an indication of a profitable en prise. People do not generally go to law over worthless claims. It when an enterprise, outliving the perils of speculation, mistaken or honest management and ignorance of the methods necessary to its p ecution, begins to show signs of certain prosperity, that the last greatest enemy assails it.

The veins of Prairie Diggings strike directly toward the upper par Cañon Creek, and, very likely, belong to a system which, from its p tion, must be traversed by the numerous rich gulches and cañons ent ing the John Day's. In this belt of country, therefore, I look for furt discoveries of important and valuable quartz lodes.

CHAPTER XXXIII.

UNION COUNTY.

This county is bounded north by the Walla-Walla Valley, in Wa ington Territory, on the forty-sixth parallel of north latitude; east Snake River, which separates it from Idaho; south by Baker Coun and west by Umatilla County. Between the Blue Mountains on t west, and the ranges of Eagle Creek and Powder River on the east the large agricultural and grazing valley of the Grande Ronde. T abundant water, timber, and fertile soil of the county are causing rapid settlement by immigrants. The principal towns are La Gran the county seat, on the Umatilla and Boise mail road, Union, fift miles southeast on the opposite side of the valley, Forest Cove, Su mersville, and Orodell. The principal mining districts are in the Ea Creek Mountains, striking the eastern edge of Powder River Valley, a on Eagle Creek, a tributary of the Snake. These mountains abound gold, silver, and copper, but have been only half explored. The principal district is called Cooster. It is twenty miles square, on Pine and Eagle Creeks, and employs at present about two hundred and fifty men. The amount of good placer ground would support two or three thousand but for the scarcity and dearness of water. Bronk & Petre, the proprietors of a ditch eleven miles long, bringing water from Eagle Creek to the claims, charge twenty-five to fifty cents per inch. More than a dozen quartz ledges have been more or less prospected. The Knight ledge, on which Carter & Co. and Bronk & Co. own claims, varies in width from six inches to four feet. The former firm has a small [illegible]-stamp mill in operation. The Gem lode is occupied by two companies, the La Grande and the Humboldt. The ore contains more sulphurets than pure gold, and the companies are both in debt and idle. The La Grand Company has a 10-stamp mill, and the Humboldt Company a 10-stamp mill and arrastra. Neither the mining nor the metallurgical operations appear to have been intelligently and skillfully carried on. The only apparatus for saving gold in the mills was copper plates, which, of course, were ineffective in the treatment of the sulphurets.

Concerning the lake district, which lies in Evart, Jackson, and Wasco Counties, Oregon, and Siskiyou County, California, Mr. J. Wassen writes in the Overland Monthly for February, 1869, as follows:

Coming from the northeast, the Blue range of Oregon, (a continuation southwest of the Salmon,) the Cascade range from the north, and the Sierra from the south, blend into or form a vast steppe or table-land of lava and sage fields, interspersed with a score of lakes in size varying from five to forty miles in length and proportionate width. This high separating belt of land and water commences at the Owyhee River, and extends westward to the mountains, running at right angles with the ocean—a length of three hundred miles, and an average breadth of one hundred and fifty. There are three distinct chains of lakes in this district: the eastern, known as the Warner, inclusive of the Harney and Malheur. The second chain of lakes may be called the Goose Lake, including its northern links—Abert, Silver, and other smaller lakes. Goose Lake nestles in the extreme north end of the Sierra and is the source of Pit River, the main branch of the Sacramento. This fact has been disputed, owing, perhaps, to the outlet being underground in the dryer seasons. The third and last and larger of the several chains is the Klamath, embracing Wright and Rhett Lakes further south. The Warner lakes string along more like a river, and the rapid current, setting north at all times, is suggestive that this line of water is really the outcropping of a long subterranean stream. The amount of water is apparently more than the natural drain of the country adjacent, and the outline of a great river channel is distinctly traceable to the lakes of Harney and Malheur. The latter, however, are strongly tinctured with the alkaline soil surrounding. The variety and great quantity of fish for which the streams feeding these lakes are noted; the myriads of water-fowl of every conceivable species that make these lakes their summer resort, and the countless numbers of deer, antelope, and larger game, contribute principally to make the district of the lakes what it surely is, the happy hunting grounds of the expiring race. They are hardly to blame for the tenacity displayed in its defense. This broad pass in the mountains from east to west, furnishing the wily savage with a hundred avenues of escape, to the right or left, with his plunder and his life. The shelving shores of the lakes furnished him warm winter shelter, and the great depressions, natural trails free from snow in the severest seasons. These trails are carefully flanked at favorable intervals with little bastions and semi-circular breastworks of loose stones, mementoes of Indian skill and strategy. Aside from any known or prospective material resource, the district of the lakes, with its dense forests and weird deserts, picturesque mountains, and delightful valleys, and silent waters inclosed by perpendicular walls of mysterious formation, must ever be a scene of enjoyment for the tourist and lover of all that is grand, beautiful, and peculiar in nature.

CHAPTER XXXIV.

BAKER COUNTY.

This is the extreme southeastern county of the State. It is bounded north by Union County, east by Idaho, south by Nevada, and west by Grant County, and contains about 5,000,000 acres. The northern half of the east boundary is the Snake River; the North Fork of Powder River, and the main river, constitute the north boundary; and the Owyhee runs for one hundred miles through the southeastern part of the county, entering at the southeast corner, and emptying into the Snake a few miles south of the old Fort Boise. The southwest part of Baker County is traversed by Crooked River, which, with its tributaries, waters numerous small valleys. This region, and the region of the lakes, was until recently so infested with hostile Indians that explorations were very difficult. It has been crossed in every direction, however, by prospecting parties, and is one of the sections in which we may look for future discoveries of importance. Malheur River crosses the center of the county from outlying ranges of the Blue Mountains in Grant County, on the west, to the Snake River, on the east. Its numerous cascades furnish abundant water-power, and it has extensive and fertile bottom-lands. Agriculture in Baker and Grant Counties requires only accessible markets to make it thrive. Nature has done all that could be demanded in the way of soil, climate, and facilities for natural roads. Burnt River and Powder River, with tributary streams in the northern half of the county, have been the scene of active and extensive placer-mining, though the resources of the region, in this respect, are even yet scarcely known. The amount of land improved in the county is about 5,000 acres, or one-thousandth part of its area. The population is estimated at 3,700, and the property valuation is $396,326. The stage-road from Umatilla to Boise and Salt Lake, the military road from the Dalles to Salt Lake, and the old emigrant road, with other practicable routes, cross this county. The principal towns are Auburn, the county seat, (unless Baker City has quite recently received that distinction,) Baker City, Express Ranch, Farewell Bend, Eldorado, Malheur City, and Amelia City.

The following are the names of the various mining districts in this county, as taken from the books of the county clerk:

Blue Cañon or Auburn, ten miles southwest from Baker City.
Sparta or Eldorado, thirty miles south from Baker City.
Pioneer or Clark's Creek, twenty-six miles south from Baker City.
Humboldt or Mormon Basin, thirty-five miles south from Baker City.
Easton or Amelia City, forty miles south from Baker City.
Willow Creek, forty miles from Baker City.
Webfoot Basin, between Powder River and Burnt River, twenty miles southwest from Baker City.
Rye Valley, eight miles from Mormon Basin, thirty-three miles southeast from Baker City.
Bull's Run, on Burnt River, forty miles from Baker City.
Oro Grande, on Burnt River.

ort Sumter, near Powder River, twenty miles west from Auburn.
ock Creek, on west edge of the valley, twelve miles from Baker City.
ocahontas, on west edge of the valley, eight miles from Baker City.
nion, on the west edge of the valley, eight miles from Baker City.

The older districts, discovered as early as 1862, and worked with more less steadiness ever since, are Blue Cañon, Pioneer, Humboldt Basin, d Rye Valley. They are all good yet, containing large areas of placer ggings that will pay from $3 to $16 or $20 per day to the hand. e Auburn camp, in Blue Cañon district, has been more nearly hausted, perhaps, than any other important one in the county; yet en at Auburn there is ground enough yet unworked to furnish profit-le employment to large numbers of miners for several years to come. e great difficulty is the inadequate supply of water. This camp is uated on a tributary of Powder River, and connected by a very fine id with Baker City, in the main valley, at present the most important d thriving town in the county. The gulch at Auburn does not supply ter enough for mining, and the principal source is the ditch of the iburn Canal Company, thirty miles long, completed in 1863, and cost-g, with reservoirs, &c., more than $200,000. There are now at work this district about 100 whites and 150 Chinese.

Shasta district contains two flourishing towns, Eldorado and Malheur y. Messrs. Carter and Packwood have 200 Chinamen at work, building litch forty miles long, by means of which they expect to furnish a ge supply of water for the season of 1870. Reeves & Co. have also a all ditch. The little work hitherto done in the district indicates that, h sufficient water, 2,000 men could find claims that would yield ndsomely.

Easton district has one town, Amelia City. The prospects in this np are good; the gold is very fine, worth $17 50 per ounce.

Fort Sumter district contains a large number of placer claims, and ne promising quartz lodes, which the owners are too poor to develop present.

Bull's Run, *Oro Grande*, and *Webfoot Basin* are new districts, which mise well.

Pioneer, *Humboldt Basin*, and *Rye Valley* are, as already remarked, ong the oldest districts in the county, and still remain among the t. They contain large areas of good placer ground. During the nmer of 1866 a nugget of 40 ounces, worth $640, was found in Hum-lt Basin. The gold from these camps varies in value from $14 to 50 per ounce. Mining is carried on with iron and canvas hydraulic s, or with ground-sluices. Rocking pays well in Humboldt Basin, re men have realized as much as $70 to $90 per day of eight hours, this rude method. There is no ground unlocated in this camp; but n the others there are many good chances yet open. Quartz ledges discovered every season; but, as a rule, placer-mining continues to too well to allow much attention to be turned to this more perma-t, but more difficult, branch. A "pocket-vein," the Niagara, in Hum-lt Basin, furnished in 1863 some remarkable specimens of quartz, lded with gold.

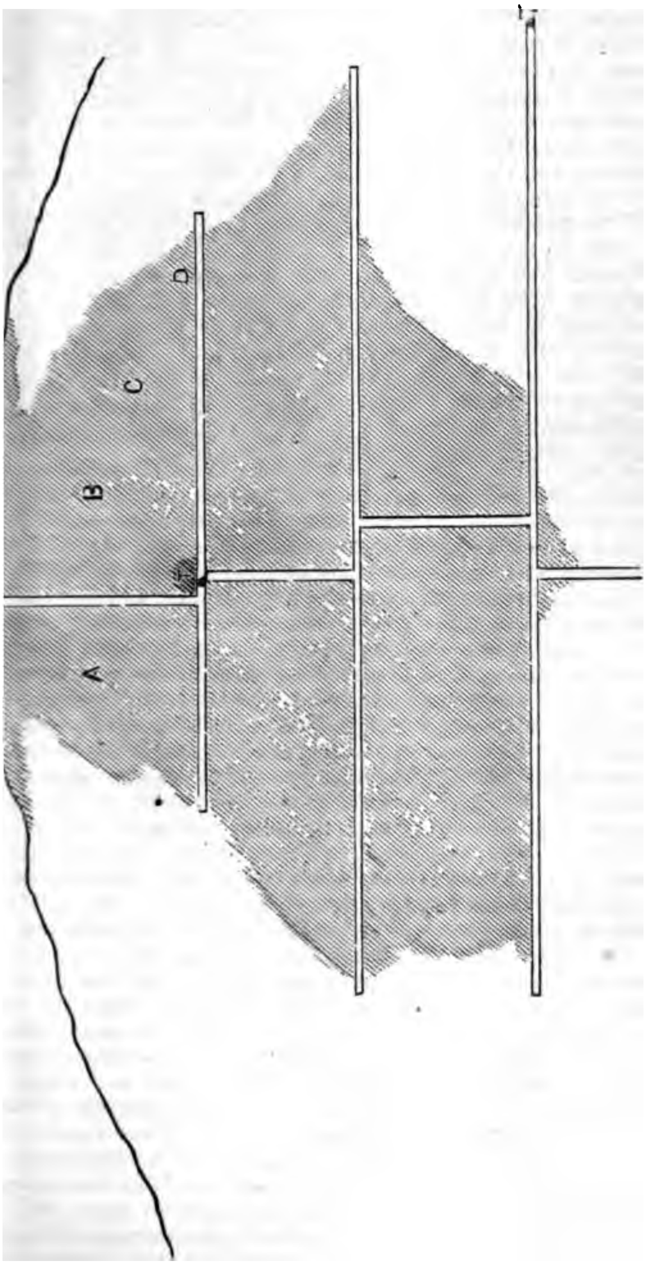
ye Valley district has been successfully worked for four years past, the gold is of low standard—about .740. The amount of silver ed with it led to the belief that silver-bearing veins might be nd in the district. Since my return from Oregon, I have received rmation of the discovery of five or six ledges of silver ore, reported be of extraordinary richness. Some of the croppings, smelted out n a blacksmith's forge, yielded at the rate of $7,000 to $9,000 per ton. One of the lodes, the Green Discovery, is 18 inches to 2 feet wide at the outcrop. These claims have been eagerly taken up, and owners are very sanguine over the expected results of next year's operations. The snow prevents active working in the winter.

There are hill, gulch, and placer mines all the way up Burnt River from Express Ranch. Coarse gold, worth $18 per ounce, is found on the steep, high points from 20 to 50 feet above the river, and the whole country is full of quartz lodes, which have furnished the gold of the alluvial deposits, but which are as yet, except in a very few localities, unknown and unheeded.

In August, 1869, a rich placer field was discovered, (reported to yield "$2 per shovelful of dirt,") on a small stream entering Snake River, a few miles below the mouth of Burnt River, fifty miles southeast of Baker City. During the excessively dry season, 30 or 40 men have "made wages" on the bars of the Snake itself, where there is ordinarily too much water to permit bar-mining.

Union district contains nothing of importance except the somewhat celebrated gold mine of Colonel Ruckel. This is situated eight miles east of Baker City, on the eastern slope of a range of hills, overlooking a large interior basin, across which for many miles may be seen the gleaming, white, dusty line of the old emigrant road. The hills are usually covered with bunch-grass; but this, at the time of my visit, had been devastated by creeping fires, giving to the whole landscape an inexpressibly desolate appearance. The little gulch which crosses the vein or veins of this mine, and debouches into the plain below, is possessed, however, of a good spring, and presents, even in a dry season, some touches of greenness. I believe the quartz lodes were discovered by teamsters, tracing up the float-quartz found in the gulch, which was successfully worked as a placer for some years. There are a few other locations, but nothing developed.

The workings are on two veins, or two parts of the same vein, called respectively the Union and the Rocky Fellow, the principal mine, shown in the diagram, being on the Rocky Fellow. The course of the latter, which appears to be the main lode, is northwest and southeast, along the east face of the mountain; and its dip generally northeast, but varying from 45° to 80°. The Union workings on the northwest show that vein to course some 20° nearer east and west; and this course would inevitably bring the two together. I think the vein exposed in the principal mine includes both branches united into one vein. The workings have not been connected so as to show the point of junction. This vein varies in width from six inches to twelve feet, averaging three feet. The outcrop is perhaps 600 feet or more above the great valley, and a little more than 300 feet above the point in the foot-hills, where the company's house is situated, near the spring. The ore is quartz, carrying free gold, with a very small proportion of sulphurets of iron and copper. Much of the quartz has a milky appearance, and shows green spots and stains, (not copper,) like that of the mother lode in Mariposa, California. The best quartz is banded, and full of dark spots and seams. It is said to be pretty hard to crush, but to have yielded for months more than $20 per ton. The position of the mine facilitates opening by cross-tunnels, two of which have been run; the first or upper one 292 feet vertically above the house, cutting the lode at 105 feet from its mouth; and the lower one, 122 feet above the house, cutting the lode at 424 feet, and 190 feet vertically below the outcrop. The ground laid open by these tunnels and the drifts shown in the diagram has been nearly exhausted. To the southeast the vein grows harder and poorer, elieve there is little encouragement to extend the drifts in that n. To the northwest it apparently divides, and possibly the takes the best part of it. The most promising direction for open-



RUCKEL'S OR UNION MINE, NEAR BAKER CITY.—Scale 100 feet to the inch.

The portions stoped out are shaded. At A, the vein was good, and measured three to four feet; at B, there was a rich chimney in a 12-foot vein; at C, a horse set in; at D, the quartz is poor. T T are cross-tunnels, driven from the hillside.

w ground is therefore in depth, and a shaft has been sunk for a vel below that of the long tunnel. The timbering throughout the

works is good, and the tunnels and shafts give excellent ventilation a
perfect drainage. The new workings below the tunnel level are r
much troubled with water, as there seems to be for the small quanti
of water in the hills a subterranean outlet to the spring at the base. (
the Union vein a shaft has been sunk 90 feet, and much quartz extract
from drifts and stopes said to have yielded in the aggregate $30,0
No machinery has been required in the main workings hitherto, exc
the cars which transport on to the mouth of the long tunnel, wh
it is dumped into wagons and hauled to the 12-stamp mill at Bal
City. Under these favorable conditions, the cost of extraction bei
only $4 per ton, and the cost of hauling $4, the mine has yielded la
profits; but outside operations are said to have embarrassed the p
prietor, and the property is now, I am told, involved in litigation. O
a few men were at the spot when I visited it, and the mill was standi
idle. This mine has every appearance of extraordinary value; but
has been pushed hard for immediate revenues, and the result is, t
new ground must be opened before the former flourishing product
can be renewed. Its well-defined, persistent, and productive charact
and the fact that it is the only development of the kind, to my kn
ledge, in a county which, I am convinced, will hereafter take a h
rank in quartz-mining, led me to give it a careful examination. I tr
it will soon be worked again with vigor and success.

SECTION IV.—IDAHO.

CHAPTER XXXV.

GENERAL REMARKS.

The boundaries of this Territory have been changed so often that a escription of the present lines may not be amiss.

Idaho adjoins on the north the British possessions; its western oundary is formed in its northern part by a line running along longiude 40° west, which separates it from Washington Territory, to a point ear latitude 46° north; from here it follows the course of the Snake iver to the neighborhood of latitude 43° 45′, when it follows again the ne along longitude 40° west, to the intersection of the northern line of he State of Nevada in latitude 42° north. Its southern boundary line llows that latitude eastward to about longitude 34° west, where it eets the western boundary line of Wyoming. From this point northard the eastern line separates the Territory from Wyoming to near atitude 44° west, and from here on it takes a northwesterly course along he summit of the Bitter Root and Rocky Mountains to a point in about atitude 47° 40′ north and longitude 39° west, and then runs along longiude 39° to where it crosses the national boundary line on the north. he Territory adjoins on the east Wyoming, a small part of Dakota, nd Montana. Its area is at present 86,294 square miles. The Terriry is drained by the tributaries of the Columbia River, the principal es of which are Clark's Fork in the north and the Snake River with s affluents, the Clear Water, Salmon River, Payette, Boise, and many aller ones in the south. It is copiously watered and very mountainous.

The principal quartz mines are situated in the southwestern part of aho, in Owyhee, Idaho, Boise, and Alturas Counties, the former taking e lead. Placer diggings, more or less extensive and important, are und in almost all parts of the Territory; the best known and most osperous ones are those of the Boise basin, those along the head-waters the Salmon River, the Clear Water, and the Kootenay diggings.

Idaho, like most of the Pacific mining districts which depend mainly on placers for their production of gold, has suffered severely from the traordinary lack of water during the present season. Indeed, it may nost be said that there has been no season this year at all, so early l the streams upon which the miners rely fail to supply water sufficient the ditches and sluices. There has been a little bar mining rendered ssible by the low water in the Snake, Boise, and other rivers; but I ve heard of nothing remarkable in the way of profits from this source. obably it has merely paid small wages to a few men who were willing adopt this method of occupying the time until either fall rains or ring thaws should enable them to return to their more remunerative ims. This state of things is always favorable to new discoveries. e active and enterprising pioneers in the mining regions, when they forced to leave their regular employment, generally start out on prosting tours. It is actual economy to take a horse, a pair of blankets, l a few supplies, and travel in the mountains for a few weeks, rather than remain in Boise or Idaho City, paying board and earning nothing. When work slacks and trade is dull, the knowing ones begin to prophesy new discoveries, and this will no doubt continue to be the case as long as any considerable portion of our inland basin and Pacific slope remains unexplored.

Another circumstance, favorable to such discoveries, is the termination, in 1868, of a long and vexatious Indian war in Idaho and Eastern Oregon. The bitterly hostile bands of outcast Shoshones and other tribes which infested the Owyhee, Powder River, and Snake Valleys, rendered it dangerous for small parties to traverse those regions, and almost impossible for them to stay long in any one locality and pursue the peaceful work of discovering and testing metalliferous deposits. The vigorous and persevering policy of General Crook, who is perhaps the best Indian fighter in the United States Army, brought the war to an end, and broke, I think forever, the power of the savage enemy. I regret to see that some depredations have recently occurred in Idaho; but in view of the overwhelming defeats and losses sustained by the Indians during the Crook campaign I cannot believe that any serious trouble will again arise in that quarter. At all events, a large area of territory has been open to exploration during the past summer, and prospectors have doubtless made good use of the opportunity. Many of the reports brought in by prospectors, under such circumstances, are no doubt colored by the sanguine temperaments of the parties. Only hopeful men can bear the fatigues and hardships of such expeditions. Their glowing stories fall upon the ears of many who have for the time nothing to do, and to whom a journey of a few hundred miles in the wilderness is but a trifling labor, if not actually a pleasure. The merchants, also, whose goods are lying on their shelves, unsold, by reason of the cessation of active mining operations, look with favor upon anything which will create "a little excitement," and revive business. They can at least send off and dispose of a few wagon loads of otherwise unsalable merchandise, before the real value of the new Eldorado has been determined.

Making allowance for all these sources of exaggeration and error, however, I think some of the reported discoveries of the present year in Idaho will prove important. The diggings on Loon Creek have attracted much attention, and will probably produce, this year, considerable gold. And finally, it must be borne in mind that all these alluring, but comparatively short-lived, surface operations are but preliminary to the discovery and exploitation of quartz veins, in which Idaho is, I am persuaded, by no means deficient.

Mr. W. A. Atlee, agent of Wells, Fargo & Co. at Boise City, estimates the product of the Territory in gold dust and bullion as follows:

District.	1867.	1868.
Placerville	$363,237	$340,5[illegible]
Centerville	468,536	442,4[illegible]
Pioneer City	494,931	522,[illegible]
Idaho City	3,001,568	2,961,[illegible]
Boise City	1,048,716	1,162,[illegible]
Owyhee City	1,000,000	1,400,[illegible]
Lemhi City	250,000	750,000
North Idaho	1,875,000	1,875,000
Other mines	497,992	545,[illegible]
Total	9,000,000	10,000,000

The same gentleman estimates the product for 1869 at $8,000,000—a decrease of $2,000,000. My estimate for Idaho in 1868 was only

$7,000,000, instead of $10,000,000; and I am still reluctant to admit so great a difference, though the express agencies are better authorities than that on which I was then obliged to depend. I have reduced Mr. Atlee's figures for 1869 to $7,000,000, on the strength of my own observations concerning the enforced inactivity of the placer miners during a great part of the season, in many of the most important and hitherto productive camps. These localities will revive again the coming season, which promises abundance of water.

CHAPTER XXXVI.

OWYHEE COUNTY.

The mines of this county have been repeatedly described in official reports, and I therefore confine myself to a condensed statement, mainly in tabular form, showing their condition in July, 1869, and the production for the year closing at that date. The shipments from these districts amounted in 1867 to $1,000,000, and in 1868 to $1,400,000. This was not equally distributed among different months, however, for the year ending June 1, 1868, showed a production, according to the assayers' reports, of $1,590,378. The year ending July 1, 1869, as shown in the annexed returns, gives $1,059,500, and the calendar year, 1869, for which I have not received full returns, will probably give not far from the yield of 1868. Good authorities expressed in January the opinion that the production of 1869 would be $2,500,000; but this anticipation was not realized. Prominent among the causes of disappointment was the sudden collapse of the Rising Star mine in Flint district, and the continued poverty of the Poorman in Silver City district. I give, in addition to the tables, a few diagrams of important and well-opened mines, as occupying less space and at the same time giving a clearer notion than verbal descriptions.

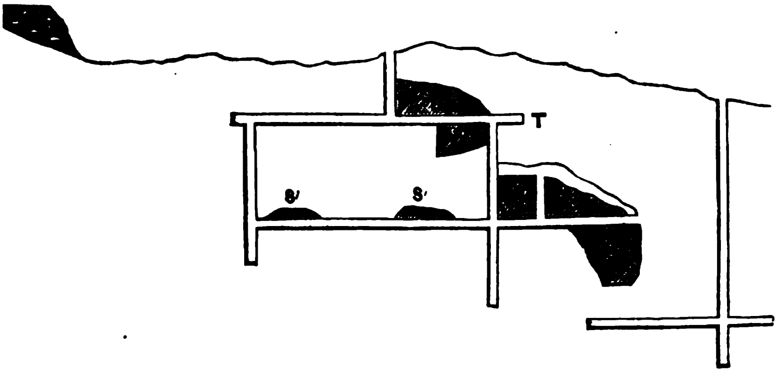
Return of the production of gold and silver in Owyhee County, Idaho Territory, for the year ending July 1, 1869, reported by John M. Adams.

Mill.	Owners.	Location.	Mine.	Number of tons of ore.	Average yield.	Total product.	Time of running, days.	Average number of stamps running.	Whole number of stamps in mill.	Power.
Owyhee	Owyhee Mining Company	Ruby City	Slum Sundry Poorman Golden Chariot	6, 000	$74 00	$444, 000	237	15	30	85-horse—steam.
Ida Elmore	Ida Elmore Company	Silver City	Ida Elmore	3, 361	101 50	341, 000	270	10	20	60-horse—steam.
Sinker Mill	Individuals	Sinker Creek	Golden Chariot Sundry	1, 700	78 00	134, 000	130	10	10	Steam.
Ainsworth	Individuals	Sinker Creek	None						10	Steam.
Morning Star	Morning Star Company	Silver City	None						8	Steam.
Cosmos	Cosmos Company	Silver City	Silver Cord	600	30 00	18, 000	50	8	10	Steam.
Jackson	Individuals	Silver City	Custom	100	40 00	4, 000	20	5	5	Steam.
Shoenbar	Individuals	Silver City	None						5	Steam
Minear	Individuals	Silver City	Custom	200	30 00	6, 000	30	5	3	Steam.
Rising Star	Rising Star Company	Flint district	Rising Star	1, 000	90 00	90, 000	50	25	33	Steam.
Black's Mill	S. J. Black	Flint district	Custom	100	100 00	10, 000	30	5	5	Steam.
Iowa	Iowa Company	Flint district	None							
Ore from sundry sources at various times.				185	67 50	12, 500				

Total production, $1,059,500.

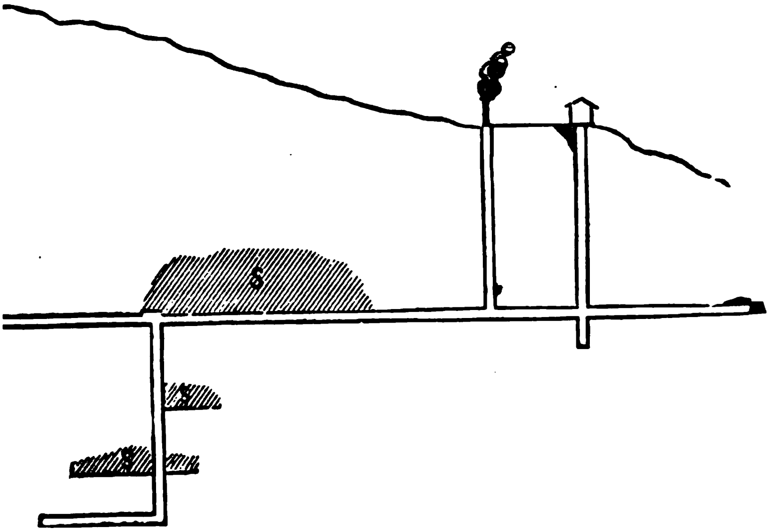
***Remarks.*—These mills are all wet-crushing and amalgamating with the exception of the Rising Star and Black's, which are dry-crushing, roasting, and chloridising, and the Iowa, which uses Dodge's crusher and grinder.**

n courses north and south, (north is to the right hand in the sec- and dips 70° east, varying in width from one to fourteen feet. It seen that there are three distinct openings, unconnected with each



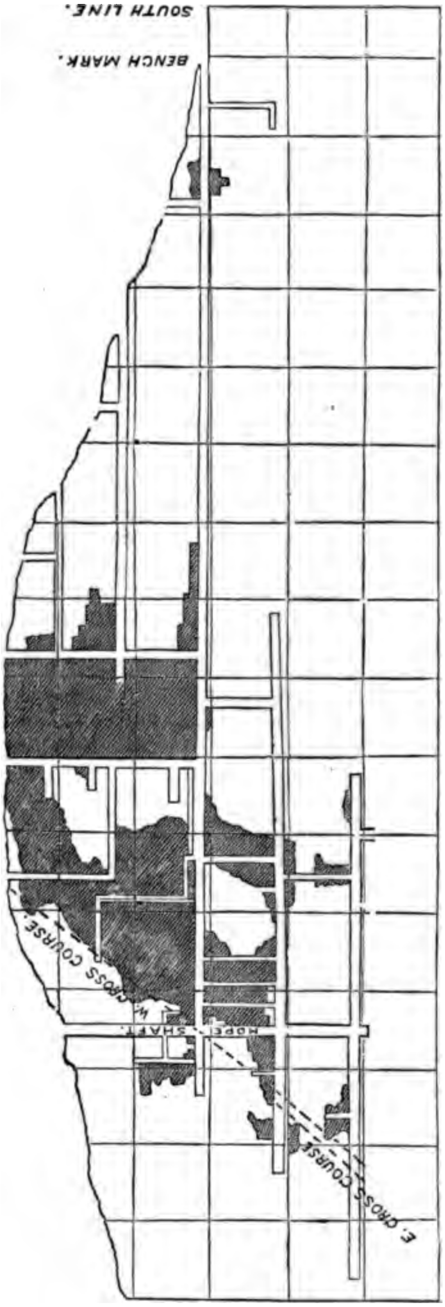
ALLISON MINE, OWYHEE DISTRICT.—Scale, 100 feet to the inch.

Of these the northernmost belonged to one party, and the princi- pes, with the shaft and tunnel on the extreme left, to another. The ground is now consolidated, and the mine leased to the Owyhee any. The deepest shaft is 155 feet below the surface. It exposes e body of low-grade quartz on the foot-wall. At the bottom two good quartz ($150 per ton, mill value) come in suddenly on the ng wall. At T, a cross-tunnel, 72 feet long, cuts the vein. At the of the shaft at the extreme left begins the upper tunnel, of which mp only is shown in this section, and continues southward on the 40 feet, carrying, it is said, fine ore at the further end. A is the



MORNING STAR MINE, OWYHEE DISTRICT.—Scale, 100 feet to the inch.

g of the original Allison Company, from the cross-tunnel T. S, the stopes of the Lincoln Company, of Rhode Island, which suc-



POORMAN MINE.—Scale, 240 feet to the inch. The lines forming the squares in the diagram indicate distances of 100 feet each.

ceeded to the ownership. At S, above the upper level, the vein wa
a half foot wide, and the ore worth $60 to the ton; at S, above tl
level, the vein was 14 f
but the quartz was w
$10 per ton; at S. l
second level, there w
veins, each one and a
wide. The ore yielde
ton, (assays, of course
The lowest level, conne
the north shaft, now c
at both extremities, a
body of reserves may l
ered as almost open
ore of the Allison con
timonial sulphurets, v
tle iron pyrites, &c.,
white quartz gangue.
to me to resemble
some of the Reese Ri
It is to be hoped
Owyhee Company, n
ing the mine, will s
retrieving by it the di
ments occasioned by
tuating condition of
man mine.

Vein courses north
(north is on the right
the section,) and dips
country rock, granite.
lowest workings the v
feet wide, and of fine
say $200 rock. The o
mine is characterized
ish stains. It cont
phuret of silver, &c. P
its proportion of go
bullion is worth $
ounce. The length of
is 800 feet. The locat
different stopes, S, ind
distribution of rich
stope above the uppe
40 feet high by 100 f
This mine contain
ground which could
opened with the seco
securing abundant
The upper level exten
further south than is
the diagram.

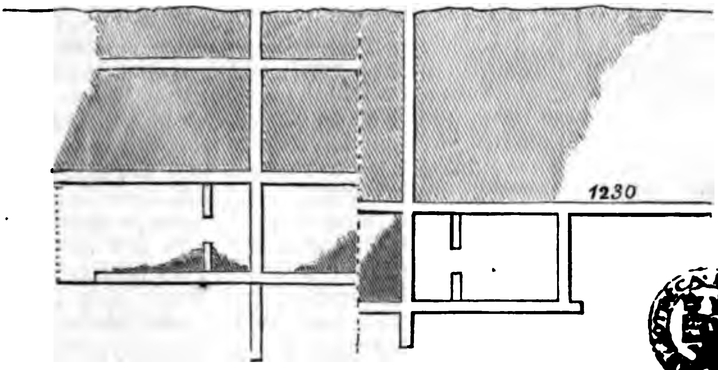
Poorman Mine.—Th
erty belongs to the Owyhee Silver Mining Company. Full des
of the vein, the ores, &c., together with statistics of the yield
periods, will be found in Mr. Browne's report for 1867, and m

1868. I shall content myself here with a diagram of the workings, which will illustrate former accounts.

The reports from this mine have been anything but satisfactory during the greater part of the year. The above diagram indicates the extent of the workings, and the locality of the two great chimneys from which the enormous yield of the mine in former years has been produced. As these bodies appear to dip northward on the vein, it seemed to me likely, on personal examination, that a third line of deposit might be found in the unexplored ground to the south of the lower workings. This belief was strengthened by numerous indications, which I will not here discuss, especially the occurrence in the tunnel, near its mouth, of a mass of rich ore, which seemed like the upper extremity of a larger body, or a chain of deposits. Since my visit a winze has been sunk from the lower level south into a body of fair milling ore 50 feet, thus corroborating to some extent the views I had formed. The vein appears to take a sudden turn, and dip about 60° to the east. The prospects of the company are considerably improved by this discovery, and as the mill, running machinery, roads, and other facilities are now in good working order, and no expensive litigation rests upon the enterprise, it may be expected that the stockholders will profit by future production to a larger extent than heretofore.

Golden Chariot and Ida Elmore.—In regard to the first mine I take the following from a recent report upon the property by Mr. William Ashburner, mining engineer:

The length of the claim upon the vein is 750 feet, and it is part of what was formerly known as the Ida Elmore, the northern portion of the claim being still worked under this name.



THE GOLDEN CHARIOT AND IDA ELMORE.

The vein runs very nearly north and south, with a steep inclination to the east. It is encased in a hard granite, and varies in width from one to four feet.

The ore taken from the mine is exceedingly rich. It consists mainly of quartz associated with free gold and silver and sulphurets of silver. It yields in the mill from $125 to nearly $200 per ton; the yield for December, 1868, having been at the rate of $190 74, and that for January following $154 08 per ton.

The Ida Elmore Company, whose works adjoin those of the Golden Chariot on the north, and which is raising ore in every respect identical with that produced by the Golden Chariot, ran a 10-stamp mill during the last year for ten months, upon rock which averaged during this whole period $148 per ton. The owners of this mine assure me that their gross production, since the autumn of 1867, has been in the neighborhood of $1,000,000.

The Golden Chariot mine is worked through a shaft 250 feet deep, sunk upon the vein 105 feet south of the northern line of the claim. The first level is 47 feet from the surface, and has been run north to the Ida Elmore line, and south 159 feet, at which point the ore became of an inferior quality, and work was suspended. Above this level all the ore has been removed to the surface.

The second level is 100 feet below the first, or 147 from the surface. North of the shaft, on this level, nearly all the ore has been worked out to the Ida Elmore line, leaving about 75 tons, which will be removed early in March. South of the shaft the drift has been extended 209 feet through ore which was of excellent quality most of the distance. Stopes have been raised from this level toward the one above, and it is from this portion of the mine that most of the ore is now being taken. The vein at the southern end of this drift was 16 inches wide, and work will be continued in this direction until the end of the ore shoot is reached.

It will be seen by an inspection of the accompanying map that the shoot is at least 50 feet longer on this level than it was on the one above.

The shaft has been sunk 104 feet below the second level, and drifts have been started from the bottom both north and south. The vein at the southern end of the drift is fully 3 feet wide, and the ore excellent, while at the end of the northern drift it is about 32 inches in width.

As soon as stopes can be opened in these drifts, the work of sinking the shaft will be continued.*

The accompanying map of this mine shows the extent of the underground works as they existed at the date of my examination. Above the first level all the ore has been removed for a length of 265 feet.

Between the first and second levels north of the shaft, there is a block of ore standing which will furnish about 75 tons. South of the shaft, above this same level, there are about 1,125 tons remaining.

Below the second level, and down to the bottom of the shaft, the vein has been explored on two sides, and partially on a third, and there are no indications which would lead me to suppose that the drifts which are now being driven north and south will not develop ore equal in value to that found above. The second level passed through excellent ore in both directions; the shaft has explored the vein 104 feet below the stopes; the appearance of the lower drifts is very satisfactory, as exposing ore of more than average width; and finally, the Ida Elmore shaft, which has been sunk 50 feet north of Golden Chariot line, about 30 feet lower than the shaft of this latter company, shows at the bottom, as I understand, the vein as being of good width and carrying excellent ore. While I entertain no doubt of the truth of this statement, I was unable to verify its accuracy by my own observation, as there were several feet of water in the shaft, and the sides were being timbered. I was able, however, to examine a point 54 feet down, which would correspond to a level 24 feet above the bottom of the Golden Chariot shaft, and there saw the vein of more than average width, and carrying ore equal to any that has been taken from the mine.

If we now assume the length of the ore shoot on the third level of the Golden Chariot to be no greater than it has already been found in the one above, and that the vein preserves the same average width, the block of ground will yield more than 4,000 tons, or enough for thirteen hs' work at the present rate of production, after all the ore above econd level shall have been exhausted.

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* Recent advices from the mine state that this work has been already commenced, *and that* there is a great improvement in the appearance of the vein in the shaft.

e ore derived from this mine is being milled by the New York and iee Company, at a price which varies from $16 to $20 per ton, ding to the richness of the rock. The work performed by this any is excellent, and the results compare most favorably with those ned by any other mill in the country. The tailings assay only $8 to $13 per ton, or from seven to eight per cent. of the original nts of the ore.

e monthly product of this mine at present varies from 300 to 325 and the total expenses, including mining, milling, transportation e from the mine to the mill, a distance of 2¾ miles, and all dead- , are from $15,500 to $17,000 monthly.

ese expenses, when applied to the ton of ore, appear high, but it be borne in mind that the vein, though rich, is narrow, the country is hard, and labor costs quite as much in Idaho Territory as in any e more recently discovered mining districts of Nevada. Giant ler is used with great advantage and success in this mine in sinking shaft, and will be, I am told, employed in the stopes. If so, an omy of probably not less than twenty-five per cent. can be realized ı the cost of mining.

e mine is provided with all the machinery necessary for successful king. The hoisting works are powerful, and amply sufficient for the ent working and future development of the property. No difficulty perienced from water; as the mine is comparatively dry. All the dings are new and substantial.

he Golden Chariot has paid dividends to its stockholders during the iter part of the year, but I have been unable to learn the gross unts of production, expenses, and dividends. The only items which e come under my observation are the bullion product for January, ruary, and October, 1869, which have been respectively $45,630 88, ,027 24, and $31,205.

he Owyhee Avalanche, February 9, has the following review of the ing fields:

> hile on a tramp over the War Eagle mountain last Tuesday, we called at the Gol- Chariot mine. The main shaft is now nearly four hundred feet deep, showing a from two to three feet in width, richer than ever in silver, but with a less propor- of gold than nearer the surface. Most of the ore now worked is taken from the th level, both north and south of the shaft. The vein is large and immensely rich h, and shows good average pay south. Considerable fine ore is also being taken the third level. After sinking about sixty feet deeper, another level will be ed, which will furnish large quantities of quartz for an indefinite long time. A wire rope is used for hoisting purposes, and is well liked. The engine-room, black- h shop, carpenter shop, and ore-house are conveniently arranged and are kept in et order. A chief feature of the establishment is the most excellent ventilation e mine. A superabundance of fresh air is forced through a large pipe to the low- epth of working, by means of a machine attached to the engine, and works ad- bly. Ore continually rattling down in the shute, and teams busily engaged in ing it away, presents a scene of activity that augurs well for the business pros- ty of the camp.
>
> rth of the Chariot some thirty or forty yards are the works of the Ida Elmore. new engine-house and appurtenances are of the most substantial kind and ap- ed order. The waste dump is the best in the country, and will afford unlimited ities for many years. With Mr. Schmidt for our guide, we explored the various es, tunnels, and shafts, and everywhere observed evidence of the far-famed and -merited richness of the Ida Elmore. The greatest depth to which it has been ked is 407 feet, where the vein in size and quantity resembles that of the Chariot, pt the quartz is softer, and consequently easier worked. It does not take much e than half the number of hands to supply the company's mill with ore as when king nearer the surface, where it was harder. As in the Chariot, most of the rock ken from the fourth level, although work is also actively going on in the third.

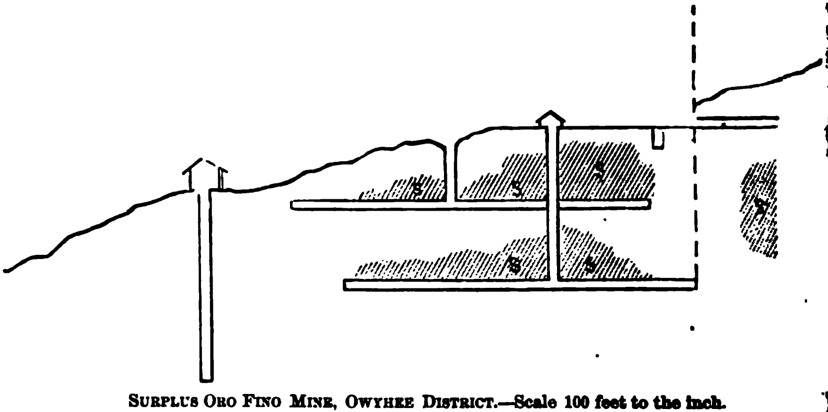
The main shaft will be put down about twenty feet further, and then stoping will commence in the fifth level. The deeper the mine is worked, the wider and more regular does the lode become, and, as is characteristic with other mines in Owyhee, the gold is displaced by silver, affording better average pay.

A fierce snow-storm on the mountain prevented us from seeing a number of other mines, from which we hear good reports. Good pay rock is being taken from the Home Resort, discovered by the unfortunate suicide, Chauncey. Judge W. R. McDaniel and party have leased the mine with a good prospect of making it pay, as the ore is rich in gold.

The Baxter shaft is down 220 feet, and is yielding silver ore scarcely inferior in richness to any in camp. We were shown a large piece of quartz, recently taken out, all sparkling with ruby-silver. The Corduroy mine is worked by contract. Quite a sensation has been produced by a rich strike just made. The same may be said of the Peck & Porter, which is being actively worked. A mill will be erected early next summer in the gulch close to these mines. Mr. Peck is engaged in getting the Potosi in shape for extensive working. Besides the mines above mentioned, the Poorman is being worked as usual. Work is also progressing in the Empire, near Woodstock. The Sands Brothers are engaged in prospecting a discovery made on the mountain, northeast of Fairview, last fall—said to be rich. It is rumored that the Crane & Driggs will be re-opened the coming spring. The Surplus Oro Fino will be worked again soon. This, in connection with the Oro Fino, will make things lively again in that vicinity. Taken all in all, nearly as much work is now going on in our mines as at any period during the last two years. From present prospects, the bullion shipments during the coming summer will be much greater than at any other period in the history of Owyhee.

Placer mines.—There will probably be eight hundred men employed in the placer diggings at Owyhee next spring. Men who have become tired and disgusted with hunting after a big thing, are now satisfied to work claims that will pay from four to ten dollars per day to the hand, and plenty of such placers exist in this county. The Wagontown diggings extend for twelve miles along Jordan Creek. The prospects obtained will justify working as long as water lasts. Then there is Blue Gulch and others in the vicinity of Boonville, that in many places yield excellent pay. Jacob's Gulch is not half worked out yet, and will continue to sustain its wonted reputation for big nuggets. The Florida Mountain ditch is completed, and as long as the water lasts the rich mines, hitherto untouched, on the northeastern slope of the mountain, will be worked to advantage. The placers at the head of Slaughterhouse Gulch will also receive attention, and a large quantity of ground will be worked on Sinker Creek and its tributaries. From careful consideration, we confidently believe that the coming spring will usher in a great revival of the placer-mining interests of our camp; the gold dust produced will materially add to the circulating medium and benefit the channels of trade.

The celebrated Oro Fino mine was entirely closed, on account of litigation, at the time of my visit, as it had been for a long time. The Surplus Oro Fino, herewith represented, was the only part of the ground to which I was able to obtain access.



Surplus Oro Fino Mine, Owyhee District.—Scale 100 feet to the inch.

The ground to the right (south) of the dotted line is that of the Oro *Fino*. The whole length of the Surplus Oro Fino ground is 418 feet.

stopes S have been highly productive, and the reserves are still ible. This property should really be consolidated with the Oro which would then be perhaps the most magnificent mine in this ificent district. The Oro Fino vein, from its great size (3 to 14 and regularity and uniformity of value, ($40 to $45,) has been called aster-lode of the group in which it is situated, comprising the Ida re, Golden Chariot, &c. This vein certainly offers a fine mining id, and it is to be regretted that legal complications have, for sev- rears, kept these valuable mines from being worked. During the part of the year 1869, I learn the Oro Fino was worked under temporary arrangement.

e mill of the Owyhee Company is in excellent condition and skill- managed by Mr. John M. Adams, the first graduate, I believe, of olumbia College School of Mines, in New York.

is mill has twenty stamps weighing a little over 650 pounds each, 9½ inches, speed usually 68 per minute, punched screws, 144 holes e inch. There are also 10 Wheeler pans, 6 Varney pans, 8 settlers, itators, a 6 horse-power Blake's rock-breaker, 1 lathe, and 2 Hun- rd's concentrators. These are all run with one engine, actually rating, under 95 pounds pressure of steam and 56 revolutions per ite, 85 horse-power. The mill, as will be seen by the table, is sup- l principally with ore from the Golden Chariot and Poorman. e differ greatly in hardness. The mill will crush 45 tons of Poor- ore in 24 hours, but only 30 tons of Golden Chariot, the same hinery being run in both cases, except that the rock-breaker is ired for five hours per day to reduce the Golden Chariot ore to size. In practice, there is an occasional stoppage of a battery amps) for setting, &c., so that the average duty is not over 40 tons oorman, or 28 of Golden Chariot. In the former case, 6½ cords of d per day are consumed as fuel, and the engine easily drives all the hinery; in the latter, 7½ cords are required, and the engine is scarcely quate to its work, or at least is taxed to its full capacity. The dif- nce in the strain is partly in the breaker and partly in the pans, re the greater amount of hard quartz in Golden Chariot ore causes eased friction. Each Wheeler pan requires on an average 2.8 horse- er, and receives at a charge 900 pounds of Golden Chariot or 800 nds of Poorman, the latter needing to be mixed with more water i the former. Each Varney pan requires about 2.7 horse-power and ives 800 pounds of Golden Chariot or 700 pounds of Poorman. The l of 85 horse-power from the engine may be divided as follows, fric- , &c., being included:

	Horse-power.
amps	20
heeler pans	28
arney pans	16
umps	5
ttlers	7
gitators	2½
ncentrators	½
ock-breaker	6
Total	85

heoretically, 20 stamps of 650 pounds, dropping 9½ inches, 68 times minute, would require a little over 21 horse-power, even apart from ion and weight of gearing, but the accumulation of ore in the mor- decreases the height of fall somewhat and leaves the above estimate tically correct.

Exhibit of producing mines in Owyhee County, Idaho Territory, on July 1, 1869, reported by John M. Adams.

Name.	Owners.	Character.	Course.	Dip.	Dimensions of claim.	Country rock.	Vein matter.	Ore.	Average value.	Mills.	Product for the year ending July 1, 1869.
					Feet.			*Tons.*			
Ida Elmore	Ida Elmore Co............	Lode..	N. & S.	80° east.	1,350	Granite	Feldspar, quartz, and calc-spar, hard.	3,361	$101 50	Ida Elmore.......	$341,000
Golden Chariot	Golden Chariot Mining Co.	Lode..	N. & S.	80° east.	750	Granite	Feldspar, quartz, and calc-spar, hard.	3,300	115 00	Sinker mill, Owyhee mill.	380,000
Poorman...........	Owyhee Mining Co	Lode..	N. & S.	80° west.	1,650	Granite	Soft, feldspar, kaolin, qu'tz, and spar.	3,650	46 00	Owyhee mill......	170,000
Baxter.............	Personal.................	Lode..	N. & S	80° east	800	Granite	Soft, quartz and feldspar..	300	33 00	Sinker mill.......	10,000
Pauper............	Personal.................	Lode..	N. & S.	East....	800	Granite	Soft, quartz and feldspar..	40	30 00	Owyhee mill......	1,200
Oro Fino...........	Oro Fino and Morning Star G. and S. Mining Co	Lode..	N. & S.	80° east	1,000	Granite	Hard, feldspar, quartz....	375	37 50	Sundry...........	14,000
Peck & Porter.....	Personal.................	Lode..	N. & S	80° east	600	Granite	Hard, quartz..............	90	48 00	Sundry...........	4,300
Silver Cord	Silver Cord Mining Co....	Lode..	N. & S.	West ...	600	Granite	Same as Poorman	600	30 00	Cosmos mill	18,000
Potosi	Personal.................	Lode..	N. & S	70° west	1,000	Granite & diorite	Calcspar and quartz	160	38 00	Sundry...........	6,080
Rising Star	Rising Star Mining Co	Lode..	N. & S.	80° east	1,000	Granite	Hard, quartz, argentiferous gray copper ore.	1,000	90 00	Rising Star.......	90,000

Remarks.—The veins of this district have a general north and south course, and are nearly vertical in dip. The Oro Fino mine has had several thousand tons of ore worked, averaging $100 a ton, but during the past year the mine when worked proved less productive, though of good width and with well-defined walls.

Name.	Owners.	Character.	Course.	Dip.	Dimension of claim.	Country rock.	Vein matter.	Ore.	Value per t by yield.
					Feet.				
Ida Elmore	Ida Elmore Co	Lode	N. and S.	East	1,350	Granite	Hard, quartz and spar	Docile	$101 50
Golden Chariot	Golden Chariot Mining Co	Lode	N. and S.	East	750	Granite	Hard, quartz and spar	Docile	115 00
Poorman	Owyhee Mining Co	Lode	N. and S.	West	1,650	Granite	Soft, decomposed	Docile	46 00
Baxter	Private parties	Lode	N. and S.	East	800	Granite	Soft, decomposed	Refractory	33 00
Pauper	Private parties	Lode	N. and S.	East	800	Granite	Soft, decomposed	Docile	30 00
Oro Fino	Oro Fino and Morning Star G. and S. Mining Co.	Lode	N. and S.	East	1,000	Granite	Hard, quartz and spar	Docile	37 50
Peck & Porter	Private parties	Lode	N. and S.	East	600	Granite	Hard, quartz and spar	Docile	48 00
Silver Cord	Silver Cord Mining Co	Lode	N. and S.	West	600	Granite	Soft	Docile	30 00
Potosi	Private parties	Lode	N. and S.	East	1,000	Dolomite & granite	Quartz and spar	Not very docile	38 00
Rising Star*	Rising Star Mining Co	Lode	N. and S.	East	1,000	Granite	Quartz, hard	Refractory	90 00
Allison	Allison Co	Lode	N. and S.	Nearly vertical	2,400	Granite	Hard, quartz	Not very docile	70 00
Morning Star	Oro Fino and Morning Star G. and S. Mining Co.	Lode	N. and S.	Nearly vertical	800	Granite	Quartz and spar	Free working	70 00
Corduroy	Private parties	Lode	N. and S.	Nearly vertical	800	Granite	Hard, quartz and spar	Not very docile	100 00
Whiskey	Private parties	Lode	N. and S.	Nearly vertical	800	Granite	Quartz	Docile	40 00
Whiskey Gulch	Private parties	Lode	N. and S.	Nearly vertical	1,000	Granite	Quartz	Docile	30 00
Home Ticket	Private parties	Lode	N. and S.	Nearly vertical	600	Granite	Soft, quartz and spar	Docile	60 00
Red Jacket	Private parties	Lode	N. and S.	Nearly vertical	1,200	Granite	Hard, quartz	Docile	50 00
Leviathan*	Private parties	Lode	N. and S.	Nearly vertical	1,000	Granite	Hard, quartz	Refractory	100 00
Twilight*	Private parties	Lode	N. and S.	Nearly vertical	800	Granite	Hard, quartz	Refractory	100 00
Astor*	Private parties	Lode	N. and S.	Nearly vertical	800	Granite	Hard, quartz	Refractory	100 00
Pompeii*	Private parties	Lode	N. and S.	Nearly vertical	3,000	Granite	Hard, quartz	Refractory	100 00
Cloud*	Private parties	Lode	N. and S.	Nearly vertical	800	Granite	Hard, quartz	Refractory	100 00
Pickens & Edwards*	Private parties	Lode	N. and S.	Nearly vertical	600	Granite	Hard, quartz	Refractory	100 00

* Flint district.

There are about 1,300 claims recorded, 500 being discovery claims. On some of them considerable work has been done, and some have paid well. The veins in Flint district will average four feet in width, and a few have been found 20 feet wide, with one or two pay streaks in them. The predominant mineral is argentiferous gray copper, associated with much iron and copper pyrites. Stibnite and the antimonial and arsenical sulphurets of silver also occur in this district in considerable quantity. Such ores cannot be worked by wet crushing and direct amalgamation, as is the case in the Silver City district. The veins of the latter district are, as a rule, small, though the Allison is in places 12 feet wide. The ore contains fine gold, native silver, simple sulphuret, and chloride of silver, with occasionally stephanite, a little iron and copper pyrites, some binoxide of manganese, and ruby-silver. With few exceptions, the ores of this district are very docile, yielding by wet crushing and pan amalgamation ninety per cent. of the pulp assay. The Allison (containing more than the usual proportion of ruby-silver) yields seventy-five to eighty per cent., and the Morning Star and Potosi seventy-five per cent., but the Baxter ore contains so much antimonial sulphuret that only fifty per cent. of the assay has been realized from it by wet working.

Estimate of costs of mining and reducing ores in Owyhee County, Idaho Territory, reported by John M. Adams, mining engineer, July 1, 1869.

Population of county: Twelve hundred.
Wages of first-class miners: Five dollars in gold per day and board themselves.
Wages of surface laborers: Four dollars in gold per day and board themselves, or two dollars and fifty cents and board.
Cost of lumber: Fifty-five dollars per thousand.
Cost of mining timber: Ten cents per foot.
Cost of common powder: Twenty-four cents per pound.
Cost of giant powder: One dollar and twenty-five cents per pound.
Cost of quicksilver: Seventy cents per pound.
Cost of freight from Winnemucca: Four and a half cents per pound.
Cost of fuel, red fir, mahogany: Eight dollars in currency per cord.
Cost of ten-stamp mill, California pattern, including freight, erection, &c.: Fifteen thousand dollars to twenty thousand dollars.
Cost of twenty-stamp mill, freight, erection, &c.: Forty thousand dollars to forty-five thousand dollars.
Minimum mining cost per ton of ore: Six dollars per ton from fourteen in ledge; seventeen dollars and fifty cents and eighteen dollars, including prospecting.
Mine from which this is reported: Poorman.
Character of rock at that mine: Granite walls, ledge matter soft.
Depth of mine: Five hundred feet; width of vein one inch to four feet; in bonanza, one and a half to four feet.
Maximum mining cost per ton: Thirty dollars, including all work.
Mine from which this is reported: Golden Chariot.
Character of rock, &c.: Granite wall; vein extremely hard; average width eighteen inches.
Depth of mine: Three hundred and thirty feet.
Minimum reduction—cost: Ten dollars per ton.
Name of mill and number of stamps: Owyhee Company Mill; twenty stamps.
Character of process employed: Wet crushing and amalgamation.
Maximum milling cost: Forty dollars per ton.
Name of mill and number of stamps: Rising Star; thirty stamps.
Character of process employed: Roasting, chloridizing, and amalgamation.
Average mining cost per ton: Twenty dollars per ton.
Average milling cost per ton: Twelve dollars, without roasting.
Average yield of ore: Eighty dollars per ton.
Remarks.—The amount of prospecting for these mines has been limited. Much surface prospecting for the veins has been carried on, and some 1,300 claims are recorded, but the amount of capital expended in developing and prospecting the mines has been very small.

South Mountain district.—The mines of this district were discovered during the latter part of 1868, and are therefore comparatively new. They e situated about twenty-two miles south of Silver City and twelve iles from Flint district. The country rock is granite and limestone. he Original, 44 feet wide and striking southeast and northwest, the alena and Young America are the principal lodes. The ores are galena, gentiferous gray copper, copper pyrites, &c., and assay from $21 to 50 in silver to the ton. The mines have caused considerable excite- ent, and are being opened. They are too little developed, however, permit of a detailed description at present.

A vein of bituminous coal has been discovered on Reynolds's Creek, o miles northwest from Ritchie's place in Owyhee County. A tunnel s been driven into the vein, which is now 30 feet in. It exposes a ickness of 12 feet of good coal. This discovery is of the utmost im- rtance for the Owyhee mines.

CHAPTER XXXVII.

ALTURAS COUNTY.

In the districts visited in this county in June, 1869, so little active ining was at that time going on that a general description will cover ost of the ground. Speaking of districts, it should be mentioned that e territorial legislature has prescribed laws governing the location and ossessory title of quartz lodes in the Territory, excepting rules and gulations for four northern counties, which the miners are allowed to rovide for themselves. One provision of the territorial law is, that the ining records shall be kept at the county seats by the county recorders. ach county is therefore in fact a single mining district; but for conve- ience the miners adopt local distinctive names for different discoveries r camps within the counties.

Rocky Bar district is ninety miles northeast from Boise City, upon a ributary of the South Boise River. A town in the heart of the district, earing the name of Rocky Bar, is the county seat of Alturas County. ines were first discovered here in 1863. The lodes are auriferous uartz, generally carrying considerable iron sulphurets, and incased in ranite. A considerable number have been discovered and located. hey are generally small, ranging in width from a few inches to three eet. Some of the smaller ones are quite rich, paying well when a few en are employed to extract the ore and work it by arrastra; but efforts o work upon a more extended scale have not proved continuously suc- essful. A few arrastras were running in June There are three stamp mills in the district, belonging to the Idaho Confederate Star and Pittsburg Companies. They were all standing idle.

The Idaho lode, which has been the leading one in the district, was worked some three years, and a large amount of ore extracted and milled, part of the time with profit. It was afterwards sold to an eastern company, who are not now working it.

There have been placers in this district of considerable productive value. The best of them have been exhausted, but others are still worked to a limited extent.

Red Warrior district is some two miles west of Rocky Bar, and likewise possesses a considerable number of locations, upon most of which there has not been sufficient work done to determine their true character and value. There is one active mining company, the Wide West, which has a lode of quartz bearing free gold, together with a considerable amount of pyrites, the gold and iron appearing, however, to be quite independent of each other. The strike of the lode is a few degrees east of north, and the dip 85° west. This vein is from two to five feet wide, well defined, and incased in granite. The ore gives a milling return of $40 per ton. The mine is worked through a tunnel, having backs sufficient to keep the mill running three or four months. A second tunnel, 100 feet lower, had nearly reached the lode at the time of my visit, and is reported by the superintendent to have since cut it, developing good ore. Connected with the mine is a 10-stamp quartz mill, run by steam-power. This mine is owned in New York, and superintended here by Mr. John McNally. It is particularly noticeable for the intelligent and energetic manner in which it is opened and worked. The same good management extends to the mill, with the necessary arrangements for saving gold. The example thereby presented of a profitable mine justifies the opinion that in the same district and neighborhood, under equally judicious control, other similar enterprises might achieve a like success.

There are two other mills in Red Warrior—the Victor, with twelve stamps, three Moore's grinders, and steam-power, and the Farnham, with ten stamps and steam-power. Through the failure of the first proprietors, both of these, together with their mining locations, have passed into second ownership, and are now idle.

There are a few placers still being worked, but most have been exhausted.

Yuba district was discovered soon after Rocky Bar, and is situated some sixteen miles north of east of that place, upon the Middle Boise and Yuba Rivers. The only active company in the district is the Monarch, an organization of Northern Indiana, having a claim of 1,400 feet upon the Atlanta lode. This lode is quartz, incased in granite, with a strike of 79° east and dip of 80° to 85° north, where I could observe it.

A ravine crosses the Monarch mine some 300 feet from its west end. The eastern portion rises some 200 feet in vertical height above the bed of the ravine. The first development made was from near the center of the location by driving east upon the outcrop into the face of the hill, where a small seam of good ore was found. This was extracted from the drift up by overhand stoping, and that part of the mine was then allowed to cave.

The developments at the time of the visit of Mr. P. S. Buckminster, to whom I am indebted for this account, were a drift commencing some 75 feet east of the ravine, and running east upon the lode some 125 feet. At this point the drift forks, one branch bearing a little to the right, the other to the left, and both extending some 75 feet further. Neither drift has developed any selvage or country rock, and as there are 15 or 20 feet of quartz between them at their ends, the lode is shown to be quite wide at this point. The right hand drift shows in face, and along its top for some distance, a very rich seam of ore, from one to four inches wide, composed of native silver, silver glance or sulphuret, and antimonial silver, (apparently pyrargyrite,) comparatively little quartz being intermixed. On each side of this seam is a low grade of ore, containing the same minerals, accompanied with considerable iron, mostly in the form of sulphuret. The full width of the pay vein will average nearly two feet. The left-hand drift has developed a seam and vein similar to the right, but wider; the rich seam is from one to six inches, and the whole pay vein nearly or quite three feet in width. A very small amount of *gold* is shown by assays to accompany the silver. These developments e some 100 feet lower (vertically) than the old workings first mentioned, which, doubtless, one of the ore veins extends. Four miners were nployed in the mine at the time.

The company has a mill with one French burr, one cast-iron grinder, ro Varney pans, and one settler, all run by water-power. Connected ith the mill is a roasting furnace. Two men were employed at the mill.

There are two other mills in this district, the Greenback, (water- wer,) owned in Northern Indiana, having ten stamps, four pans, and o settlers, and connected with the mill a sort of Dutch oven for burning e, for what particular purpose did not appear; and the Maine Com- ny's mill, (steam-power,) with ten stamps. Both were standing idle. addition to these, there were three arrastras running upon small de- lopments, not sufficiently important to justify a description.

There are many mining locations in the district. Most of those of teemed value are embraced in a tract of country about three miles uare, known as Atlanta Hill. There has been considerable work done prospecting these locations, but generally in such a scattering and perficial manner that one has far less facilities for judging them than e labor expended should afford. In several was noticed free gold, in a w a fair showing of silver, and in others traces of silver.

Rocky Bar, Red Warrior, and Yuba districts are abundantly supplied ith timber and water, generally distributed and conveniently accessi- e.

Atlanta district is a mining field of greater promise than the develop- ents of five years seem to have fulfilled. Through unfortunate selec- n of machinery and arrangement of mills the first tests of ores were r too expensive and generally unsatisfactory in result, whereas, I think, any of them should have been remunerative. Another feature, seri- sly affecting the energetic development of mines here, and equally roughout the Territory, is unjust and narrow legislation. One provi- on of the law is, that no non-resident shall make locations. The effect this absurd regulation, intended to force all outsiders to buy locations the citizens of Idaho, has been, of course, to keep out prospectors d capital from other States and Territories. The home supply of capi- l following this channel of industry is naturally very limited. Consid- ing that the mines belong to the United States, and not to Idaho, this gislation was as arrogant and illegal as it was palpably selfish and silly. s might be expected, its authors at the same time provided so ineffi- ently in other particulars as to enable men without capital or any in- ation of prospecting claims, further than to enable them to hold for eculative purposes, to make a large number of locations, and, without en doing the prescribed assessment work, to carry them year after ar, thereby obstructing legitimate mining.

Nowhere more clearly than in Idaho is shown the desirableness of a uni- rm national law, simple in its provisions, and applying to all our mineral rritory, which shall extend to prospectors all reasonable guard and otection, and at the same time protect the mines from being locked p for speculative purposes without consideration to the public or the overnment. The law should prescribe a definite amount of work to be pended upon claims immediately following their location, and some asonable amount every year thereafter. This would either demon- trate their value, or throw them open to other prospectors if the first iscoverers did not choose to develop them.

CHAPTER XXXVIII.

IDAHO COUNTY.

Warren's camp.—This district is situate on the headwaters of the Salmon River, in Idaho County. The placer mines have this year paid little more than expenses, owing to the drought and the high rate of wages paid. Chinese labor has not yet been used to any considerable extent, but it is the intention of mine owners to employ this class largely during the coming season. The yield of Warren's and the smaller neighboring camps from July, 1868, to July, 1869, has been about $550,000; the yield from January 1, 1869, to January 1, 1870, is about $420,000, $35,000 of which has been extracted from the quartz mines and beneficiated in mills and arrastras. The latter amount shows a considerable increase over last year, when the yield of the quartz mines was only $12,000.

The principal ledges in the camp are the Rescue, (gold,) the Bullion, (silver,) the Martinace, (silver,) the Keystone, (gold and silver.) the Charity, (gold,) the Sampson, (gold,) the Hic Jacet, (gold and silver,) and the Not, (gold and silver.) About $13,000 have been extracted from the Rescue. The main shaft on this vein is 120 feet deep. The vein matter in the bottom is 3 feet wide, and contains a pay streak of 18 inches. About 22 men are employed in the mine; the owners are Johnson, Sherwin & Co.

The Martinace has two shafts 60 feet apart, one 60 and the other 50 feet deep. The vein is from 3 to 4 feet wide and the pay streak, from 3 to 9 inches wide, runs along the foot-wall. The ore assays very high; selected specimens have yielded as much as from $700 to $8,000 per ton. It is owned by R. Hurley and others, but not worked at present, as the owners are without capital to erect reduction works.

The Keystone is opened by a shaft and tunnel. It has only been worked for gold and produced very good ores, averaging $75 per ton. Owned by Bemis & Sanderson.

The Charity, owned by J. Munsey and others, is not worked at present. It has produced ores yielding $40 per ton and the owners intend to start work again soon.

The Sampson is owned by Johnson & Hutton. It is opened by a shaft 40 feet deep, and levels 160 feet in length have been run. The vein carries 2 feet of good ore, averaging $35 per ton. The richest ore has been found in the bottom of the shaft.

The Bullion, owned by Crane & Co., appears to be a good ledge but is not worked at present for want of reduction works.

The Hic Jacet ledge seems to be very much broken up, probably in consequence of a slide. Five tons of assorted ore, shipped to San Francisco from this mine, yielded $170 per ton. Owned by Leland.

The Not is owned by W. P. Not. The ledge carries gold along one wall and rich silver ore along the other. It has only been worked for gold so far, the ore averaging $42 per ton; the silver ore assays from $80 to $300 per ton.

The Scot has not been properly opened as yet; its owners, Hutton & Co., have had some ore worked, however, which averaged $90 per ton.

The principal difficulty with all these mines is the great scarcity of capital. The owners cannot afford to open their mines properly, because they cannot work without immediate returns. Therefore they can work their veins only in such places where quick returns are certain, and those which require outlay of capital cannot be worked at all. The

ous wages paid so far, $5 per day, are also in the way of speedy
pment. But these circumstances embody also the reason that all
uartz mines which are actually worked in the district pay more
xpenses.

mineral in this camp seems to be deposited in two different belts,
g nearly east and west; the northern ore carries mostly gold, the
rn one silver ores. The average fineness of the gold found in the
med is about .720; the fineness of that mined south of the silver
only .610, so that the price of the gold from the whole district
$2 50 in value.

CHAPTER XXXIX.

BOISE COUNTY—NORTHERN IDAHO.

renowned placers of the Boise basin in the county of that
were first discovered in 1862, and have ever since taken the lead
the diggings in the Territory in the production of placer gold.
ll the extensive placers in Idaho they have suffered severely
rought during the last year. The principal ones are those in the
orhood of Idaho City, Placerville, Centerville, and Pioneer City.
ggregate production of these mines during 1869 has probably paid
nore than expenses.

e vein mining has been carried on in the county during the year,
e first smelting works in the Territory have been erected in the
orhood of Pioneer City, to smelt the ores of the Duncan and
a ledges, which carry silver-bearing galenas. I have been unable
n whether the undertaking has been a success.

n the placers in the northern part of Idaho I have only returns
duction from Oro Fino, in Shoshone county. This district, once
rosperous, has now only a small population, and the diggings are
worked out. Production from July, 1868, to July, 1869, $400,000,
neness varying from .780 to .820.

ence, in Nez Percé County. Production during the same time,
00. Fineness, .660 to .705.

City, northern part of Nez Percé County. Production, $210,000.
ess .840 to .865.

r Water Station, on the river of same name. Production,
00. Fineness, .820 to .870.

ke and Salmon Rivers, (bar mining.) Production of both, $120,000.
old found in the Snake River bars is from .820 to .830 fine; that
the Salmon River, .825 to .860.

siderable excitement was aroused during last summer by the
ery of rich placers on Loon Creek, Oro Grande district. Loon
is a tributary of the Middle Salmon River, distant one hundred
from Leesburg, and nearly due south of that place. The distance
old Fort Lemhi is one hundred and twenty miles, and the trail
in a southwestern direction over an exceedingly rugged country.
gon road is said to be nearly impracticable, and everything
sary for the camp had to be packed by mules so far. The bed
is a blue quartzy slate, and the principal pay streak is lying imme-
ly on it and only a few inches thick. The gold is very coarse, of a
color, and occurs rather "spotted."

Another rich district is reported to have been discovered about seventy miles northeast of Loon Creek, and still another between Warren's Camp and the Salmon River, about ten miles from the former place. No particulars have been received.

These three discoveries nearly depopulated some of the more southern counties, especially Boise, and attracted a large number from Montana. According to the latest news, however, the excitement has somewhat abated.

SECTION V.—MONTANA.

CHAPTER XL.

GENERAL REMARKS.

Not quite seven years have elapsed since the Territory of Montana s first organized as a distinct political organization. The discovery gold on Gold Creek in 1862, and particularly that of the Grasshopper ggings in the fall of the same year, first set in motion the tide of im- gration toward the region embraced in this title. The progress of the ritory during the short period of her existence is only equalled by at of California after the days of 1849. The wonderful gold deposits veloped by the early pioneers, while adding largely to the world's ck of precious metals, have carried population, industry, wealth, and ilization to a country before unknown beyond the meagre accounts of venturers, trappers, and explorers. The discoveries of Gold Creek, nnack, Alder, Last Chance, and Confederate, form the principal eras the history of her settlement. Their exploitation seems to travel in ircle. Gold Creek, almost immediately deserted for Bannack, is to- y the most promising and productive gold field. A second and more eful examination developed paying placers remarkable for richness d extent. Bannack, after a short but extraordinary yield, in turn for- ken for Alder, is again yielding largely, owing to the introduction of draulics, and when she has passed her zenith of productiveness it is r to expect that the Capital ditch will be completed, insuring a second lden harvest from the famous Alder Gulch.

No former year opened with greater promise of increased productive- ss than the last. Work in the placers had been in a measure stematized: the necessary drains for deep diggings constructed and e system of ditches considerably extended. Owing to an unparalleled outh and the consequent scarcity of water, these great expectations were t realized. A large number of claims depending upon natural water d to be laid over entirely, and in those supplied from larger streams means of ditches, the quantity was entirely inadequate to the wants the miners.

SYSTEMS OF MINING.

In placer claims the system of mining pursued is of course dictated by e nature of the deposit—stripping, where the gravel is only covered by thin layer of soil; and drifting, where the amount of subjacent alluvium too great to be removed economically. In the separation of the gold om the gravel every method has its representative. The primitive an, rocker, and long tom have nearly passed out of existence, and here the confirmation of the ground will permit, hydraulic washings d bed-rock flumes are being rapidly introduced.

Vein mining is too much in its infancy to present any remarkable atures. With a few notable exceptions work has not advanced beyond afts, tunnels, and short levels. The shafts are usually made to follow e dip of the vein. The ore and rock are hoisted by cars and buckets. five mines steam is the motive power; in the balance the work is done by horse-whims and windlasses. The system of stoping is usually adopted more with reference to immediate returns than final economic results. In one instance, at least, this short-sighted policy was carried to an extent which would have disgraced even Mexican ignorance and avidity, resulting in the temporary destruction of the mine and the financial ruin of its owners.

Of late more prudence is exercised and some attention paid toward establishing ore reserves.

In blasting nitro-glycerine has lately been introduced, but the term of probation is as yet too short to speak advisedly of results.

PROCESSES.

The stamp-mills, by which the reduction of the gold quartz is performed, are nearly all of the California pattern, differing, however, widely in the results which they achieve.

The stamps are usually arranged in batteries of five each. Their weight ranges from 500 to 700 pounds; and they are geared to drop from 50 to 80 times per minute.

Practical mill men have pretty generally arrived at the conclusion that a short, quick drop is most effectual. It keeps the finer material in the batteries in constant motion, permitting it to escape as soon as it is fine enough to pass through the screen on the copper plates without wasting power in further reduction unnecessarily. A few mills are furnished with pans, but in the majority the accessory machinery consists of one or two arrastras to rework the blanket tailings. For free-gold quartz, copper plates and arrastras have been found sufficient to obtain good results. Deeper stopings, with an increased percentage of sulphurets, will undoubtedly necessitate more complicated machinery and processes.

PAN PROCESS.

The only pan process for silver ore was used in the James Stuart mill at Flint Creek. For this purpose the mill (10-stamp) is provided with six Wheeler pans and two concentrators. No very definite process was adopted, as the amount of salt chemicals was constantly being changed to suit the varying character of the ore. From sixty to seventy per cent. of the silver in the ore was saved.

DIRECT-ACTING STEAM STAMPS.

A mill of this character was erected near Unionville. If successful and serviceable, its compactness and comparative cheapness would have made it particularly valuable in Montana, and the results which could be obtained with it were awaited with considerable interest. Unfortunately the mill, after a short trial run, was very suddenly destroyed by fire. According to general opinion the mill was a failure. Whether this result was the consequence of inherent faults in the mechanism or imperfect erection, is difficult to determine.

SMELTING.

Furnaces for the reduction of silver and copper ores have been erected at Mill Creek, Argenta, Bannack, Jefferson, and Butler. Detailed statistics of their operations will be given in the appropriate places. Upon the whole, their construction has met with but partial success. In this thod the item of labor forms an important figure; and ores to be reced successfully must be of extraordinary richness to overbalance the h price of labor incident to a new mining country. To eliminate the cious metals from the ore with any degree of economy, a sufficient centage of lead is necessary. In this direction smelting met a ious impediment in a peculiar feature of the veins, the ore of which it s proposed to reduce. In many of them the ore at the surface conted of pure argentiferous galena and was hence easily and profitably rked, but the amount of lead rapidly decreased to a minimum of one ten per cent. at a depth of from 50 to 100 feet. The universality of s geological phenomenon seems to point to some general law of ore tribution, although it is difficult to conceive how the filling out of the n beneath the water level, in widely extended localities, can be affected less or greater depth. Smelting, ere long, will form one of the most portant branches of the mining industries, and this period will be stened by the introduction of a thorough system of concentration, reby avoiding the fusion of barren rock.

AGRICULTURE.

According to the surveyor general's report the Territory contains ,000,000 acres of agricultural and 69,000,000 acres of grazing land. e productions for the year, according to the same authority, are:

	Value.
eat	$900,000
rley and oats	500,000
tatoes	1,000,000
y	200,000
ttle	450,000
rden vegetables	75,000
ultry and eggs	100,000
tter, cheese, and milk	400,000

Actual experience has demonstrated the entire success of agricultural rsuits, and a largely increased area of land is annually broken up by e plow, producing abundant crops of wheat, barley, oats, and vegetables. o the stranger the agricultural resources of Montana are more remarkble than her mineral wealth, because more unexpected in so northerly region.

The Territory contains a system of beautiful valleys, separated from ach other by mountain ranges and spurs. Among them the Bitter oot, Deer Lodge, Gallatin, Madison, Stinking Water, Beaverhead, rickly Pear, and Jefferson are the most important, having annually ielded abundant crops of the hardier cereals since their settlement. eside these there are numbers of smaller valleys, capable of producing verything indigenous to the Northern States.

As a grazing country, Montana stands pre-eminent. Horses, mules, attle, and sheep thrive well in the valleys and on the foot-hills. The nch-grass upon which they subsist, owing to the dryness of the atmophere, does not become withered and sapless during the winter, but emains in the highest degree nutritious. It undoubtedly possesses ore fattening qualities as it stands on the table lands in midwinter than he best hay from the bottom lands, and in wet years the growth is so xuriant that much of it is mown for hay, the quality of which is little f any inferior to sheaf oats. The grass in the bottom lands resembles, f it is not identical with, the prairie grass of the States. Considerable ild clover grows among it, and timothy, when sown, does very well. he abundance of these grasses and their extraordinary fattening qualities in connection with mild winters—which do not necessitate the feeding of stock during more than every fourth or fifth winter—render the Territory one of the very best on the continent for raising stock of all kinds.

CLIMATE.

It is a well-known fact that climate does not always depend upon latitude or altitude, and that the same isothermal line traverses localities differing widely in these respects. The experience of the inhabitants, as well as meteorological observations, have established the fact that the climate in the valleys of Montana, though situated further north, is not any colder than that of the Middle States, and that only in the more mountainous regions the average temperature is lower than in the New England States.

Locally the climate is very varied and changeable, yet such is the dryness and purity of the air that these sudden alternations of heat and cold are scarcely noticed, and do not have any injurious effects on man or beast. It is not unusual for the thermometer to rise 30 and 40 degrees between morning and noon, and fall as much between noon and 9 p.m., in both winter and summer; the fluctuations, however, being greater in winter than in summer. The days in winter, with few exceptions, are not too cold to render out-door work pleasant and agreeable, although they usually make a suspension of placer-mining necessary.

The following sketch of temperature and climate of the past few years is from the pen of Granville Stuart, and taken from the New Northwest newspaper:

> During the winter of 1857–'58 snow did not remain more than a few days in the valleys of Deer Lodge, Bitter Root, Big Hole, Beaver Head, Stinking Water, Jefferson, Madison, Gallatin, Prickly Pear, Ten Mile, and Flint Creeks. The cold was not intense, except for a few days in December and January. Cattle and horses in the open air, without any feed, except such as they got on the prairie, gained steadily in condition all winter, and came out fat in the spring. The winters of 1858–'59 and 1859–'60 were very similar, averaging, probably, a little colder and a little more snow, but quite pleasant in the main. The winter of 1860–'61 showed a gradual increase in cold and snow over the former years, but still stock did well, and the winter would not have been called a bad one in Iowa or Illinois. The winter of 1861–'62 was one of great and unusual severity, and snow falling from the depth of six inches to two feet, varying in the different valleys, and in different parts of the same valley—the points of least snow, in the respective valleys being from Willow Creek to Scarkaho Creek, (above Fort Owen,) in the Bitter Root Valley; from the Race Track to the "Deer Lodge," or Warm Springs, in Deer Lodge; from the "Backbone" down to the mouth of the river on Big Hole; from Little Beaver Head Rock down the river to the mouth of Pipestone Creek, and the lower portion of Stinking Water Valley; the valley of White Tail Deer Creek; the valley of North Boulder Creek, and of the Three Forks of the Missouri and vicinity; Crow Creek Valley and the lower end of Prickly Pear Valley. At any and all of these points it is unusual for snow to lie for more than a few days, even during the severest winters. I have observed, however, that the fall of snow is very capricious and irregular. For instance, the deposit of snow in a given locality may be quite small during a bad winter, and in the following one, even though much milder, the snow-fall at that point will be double or treble as much, while some other points, which had deep snow during the first, will be comparatively free from it during the second winter. This is more especially noticed in the higher valleys and in the passes leading from one to another.
>
> The winter of 1862–'63 was nearly, perhaps quite, as mild as that of 1857, and taking the country as far as Salt Lake, it was milder, for wagons drawn by both horses and oxen made two trips in midwinter from Bannack City to Salt Lake and back, loaded with provisions and tools, without being incommoded by snow or severe cold. This, however, is a feat that has not been accomplished since, many parties losing large numbers of cattle and mules in trying to make one trip in the three succeeding winters. The mercury in Deer Lodge fell no lower than 12° below zero, and that was in a storm on the 23d and 24th of October. The winter of 1863–'64 was but little inferior to the preceding one, snow lying but few days at a time in the valleys, although it was deeper on the mountains, and the weather averaged considerably colder. A severe storm of wind and driving snow occurred January 7, in which the mercury fell to 3[illegible]°

o, but the cold snap only lasted about a week. The winter of 1864–'65 showed
sed degree of cold and snow again. The thermometer fell to 34° below zero
re cold during December and January, but the snow was not bad until March,
ich month more fell than in all the rest of the winter, and the mercury fell
27°. During this cold snap occurred the stampede to Ophir Gulch, (Blackfoot
which many persons were frozen—the only wonder is that many did not
tright, for they were poorly clad and without any shelter. Stock did well
is winter.
ter of 1865–'66 was quite severe in the last half, snow lying in the valleys
, accompanied by intense cold, reaching 34° degrees below zero, with violent
l driving snow for some weeks. No stock died, however, this winter. The
1866–'67 was very mild up to the 24th of December, with no snow. It then
snow and get cold, and from that time until April, it was the worst winter
n the country. Snow was about twenty inches deep in the lower half of the
l from ten to twelve inches in the upper portion, with a very unusually long
ntinued cold varying from 10° to 32° below zero. The month of March was
terrific, twenty-eight out of the thirty-one days being below zero, being, I
ithout precedent in any country; yet, strange and incredible as it may seem,
ttle died, although few of them had any hay or grain and no shelter, except
's along the streams—no horses died. The winter of 1867–'68 was compara-
l, with but little snow. Coldest day 30° below zero; no suffering among the
ss abundant and not covered with snow; no sleighing in Deer Lodge during
winter; the valley dry and dusty; the same being the case pretty much all
'erritory. The winter of 1868–'69 was about the same as those of 1857–'58
53, being almost no winter at all considering the latitude and great altitude
ntry generally. No snow of any consequence; not enough for sleighing in
e. Stock of all kinds wintered fat without being fed or housed. Nearly all
at was cut in Deer Lodge was kept over, it not being necessary to use it.
n annual temperature of 1867 and 1868 was 39½° Fahrenheit. That of 1869
out 42°, it being a year of unprecedented drought and unusually warm; no
trical record kept during former years. The summer of 1857 was dry; no
kept; 1855, rather wet; 1859, dry; 1860, dry; 1861, wet; 1862, very wet;
dry; 1864, neither; 1865, rather wet; 1866, very wet; 1867, very wet; 1868,
; 1869, dryest of all.

*f meteorological observations kept by Granville Stuart, at Deer Lodge City, latitude
'ongitude* 112° 40′, *altitude* 4,240 *feet, beginning November*, 1867, *and ending July*,

nthly average is as follows: November, 1867, 30½°; December, 1867, 24°;
1868, 1¼° below zero; February, 25° above zero; March, 35⅜° above zero;
; May, 47°; June, 59¼°; July, 61°; August, 59°; September, 50°; October,
ge for the year, 39½°. The three spring months average, 41⅜°; the summer
⅜°; the autumn, 40½°; winter months, 16°.
er, 1868, 28°; December, 25⅜°; January, 1869, 20$\frac{1}{10}$°; February, 24⅞°; March,
, 42$\frac{5}{10}$°; May, 58⅓°; June, 64⅜°; July, 66½°. The winter months average
pring months 43⅜°; and the summer months, (counting August at the last
, which is too low for this year, it being much warmer,) 63⅜°.
he rate of 42½° mean annual average for this year, estimating the months to
eir last year's average, which is evidently too low, as it is much warmer.
lest day of 1868, 30° below zero; warmest, 89° in the shade; 113° in the sun.
and one-fourth inches of snow fell (in 17 different storms) in the winter of
ot including what fell in storms and melted as it fell; greatest depth at any
bout 2¼ inches, which lasted only a few days. No sleighing at all. No rain

nd three-fourths inches of snow fell (in 14 different storms) during the winter
, not including what fell in storms and melted as it fell; the greatest depth
time about 2 inches, but only lasted a few days also. Had no sleighing

in 1869: May, 1 inch; June, 1 inch; July, ¼ inch; August, $\frac{3}{10}$; September,
r (to 15) none.
ns's Northern Pacific Railroad Report, the following account, kept at Fort
ter Root Valley, Montana Territory, (75 miles due west of Deer Lodge,) in
ren:
for October, 44½°; November, 35⅝°; December, 28⅞°; January, 1855, 31⅞°;
30⅛°; March, 37⅜°; April, first half, 44⅝°; which shows an average for the
n months of 40°; winter months, 30⅛°; and two first spring months, 41°;
ws that winter to have been still warmer than either of the two last. The
f Fort Owen is a little less than Deer Lodge; the fall of snow is about the
ch point. The winters are a little warmer in Deer Lodge, but frosts are of
nent occurrence in the spring and autumn.

Extract from the meteorological register at Fort Shaw, Montana Territory. Observations covering a space of two years.

Month.	Monthly mean of thermometer.	Monthly mean of hygrometer.	Monthly mean of dew point.	Number of days fair.	Monthly average of amount of cloudiness.	Number of days cloudy.	Number of days of rain.	Number of days of snow.	Monthly amount of rain and melted snow in inches.	Highest observed temperature.	Lowest observed temperature.	Monthly mean direction of the wind.	Monthly mean force of the wind.	Remarks.
1867.	°	°	°							°	°			
October	50. 81	42. 58	34. 03	26⅔	....	4⅓	0	2	. 7	80	26	W.	4	
November	43. 19	36. 70	28. 82	22⅓	....	7⅔	1	3	. 28	67	— 1	W.	3	
December	27. 39	25. 91	19. 40	22	....	9	1	5	. 25	59	— 16	W.	3	
1868.														
January	11. 29	10. 37	4. 08	19⅔	....	11⅓	0	8	. 22	43	— 28	W.	3	
February	30. 18	28. 30	22. 39	21⅓	....	7⅔	0	5	. 23	66	— 24	W.	4	
March	40. 57	35. 82	29. 74	25	....	6	1	1	. 24	72	— 5	W.	4	
April	47. 47	40. 47	32. 70	23	....	7	8	1	. 97	80	31	W.	3	
May	52. 25	47. 47	42. 60	18	....	13	7	0	1. 46	85	37	W.	3	
June	64. 11	56. 69	50. 54	17⅓	....	12⅔	10	0	3. 69	91	44	W.	2	
July	70. 98	62. 22	55. 47	25⅔	....	5⅓	5	0	. 70	101	51	W.	2	
August	68. 35	56. 80	47. 68	23⅔	....	7⅓	3	0	. 37	100	46	N.	3	
September	50. 42	43. 88	36. 61	20	....	10	2	2	. 56	85	28	W.	3	
October	47. 43	40. 58	32. 98	26	....	5	0	1	. 80	83	27	W.	3	
November	36. 65	29. 27	16. 50	......	4. 19	......	0	1	. 50	70	— 9	W.	3	The form of the meteorological register has been changed somewhat from November, 1868.
December	26. 12	20. 42	— 8. 53	......	5. 04	......	0	2	. 40	58	— 28	W.	3	
1869.														
January	31. 28	28. 99	23. 04	......	3. 78	......	0	0	....	59	— 10	W.	4	
February	30. 59	27. 43	17. 95	......	4. 30	......	0	2	. 25	65	— 31	W.	3	
March	32. 60	29. 78	23. 60	......	4. 69	......	0	3	. 64	64	— 22	W.	3	
April	45. 55	39. 44	32. 42	......	3. 80	......	1	1	. 10	84	15	W.	3	
May	50. 84	49. 69	40. 76	......	2. 99	......	4	0	1. 60	89	31	W.	2	
June	65. 86	55. 02	46. 24	......	2. 92	......	5	0	1. 57	95	28	W.	2	
July	69. 46	59. 10	51. 02	......	2. 96	......	3	0	. 86	100	34	W.	2	
August	65. 94	57. 78	51. 28	......	2. 98	......	3	0	. 17	101	30	W.	2	
September	57. 67	51. 06	46. 20	......	3. 33	......	5	1	1. 33	92	24	W.	3	
Mean of 24 months	47. 23	41. 14	32. 48	......	....	......	.....	......	. 72	......	......	......	3	

anation of the figures in the column headed "Monthly mean force of the wind."—Number 1 denotes
y of less than 5 miles an hour; number 2, between 5 and 10 miles an hour; number 3, between 10
miles an hour; number 4, between 15 and 20 miles an hour; number 5, between 20 and 30 miles an
number 6, between 30 and 40 miles an hour; number 7, between 40 and 50 miles an hour; number
reen 50 and 60 miles an hour; number 9, between 60 and 70 miles an hour; number 10 greater
) miles an hour.

anation of the figures in the column headed "Monthly average of amount of cloudiness."—1 denotes
1-10 covered with clouds; 2 denotes a sky 2-10 covered with clouds, and so on; 10 meaning a sky
y overcast.

ımmaries of observations kept at other points did not come to hand
me for insertion. It is proper to observe here that Fort Shaw is
of the coldest points in the Territory, and that the climate of Dear
ge is not as mild as Beaverhead, Jefferson, Gallatin, Hell Gate, and
er Root Valleys.

TIMBER AND COAL.

ıly those aware of the great consumption of timber in a mining
try can appreciate the importance of an adequate supply of the
. Fortunately Montana is much better timbered than the Territo-
further south, although the forests are chiefly confined to the moun-
ranges. Pine, fir, and spruce abound in the mountains and cañons,
small growths of balsams, alders, willows, and aspens are found in
valleys in the neighborhood of larger streams. In the immediate
ıage of active mining operations the supply is rapidly diminished
transportation from a greater distance is necessary; but the other-
inexhaustible supply is more seriously threatened by extensive
ıt fires. During the past dry summer these have been particularly
strous, blackening an immense belt of country. The most charita-
xplanation of their origin ascribes them to carelessness or natural
ıomena, as it is difficult to conceive the degree of wantonness and
iny necessary to undertake the intentional destruction of magnifi-
forests.

al has been found in all parts of the Territory; among the principal
ts are Boreman, in Gallatin County, near the Dearborn, in Green-
Gulch, at Argenta, Bannack Summit, Birch Creek, &c., and there
ery reason to suppose that patches of coal-bearing strata will be
vered in nearly all the valleys. The coal belongs to the lignite
p. It is already used to a considerable extent in the cities as fuel,
lacksmithing, and for the manufacture of gas. It occurs in beds of
two to six feet in thickness and can be easily and cheaply mined.
e deposits are destined to form an important factor in the future
strial progress of the country, and it is to be doubly regretted that
rnment legislation at present actually forbids their development.
ally explain this I give the text bearing on the subject of "An act
the disposal of coal lands and of town property in the public
ain."

*it enacted by the Senate and House of Representatives of the United States of America in
ress assembled*, That in the case of any tracts embracing coal-beds or coal-fields
ituting portions of the public domain, and which as mines are excluded from the
mption act of 1841, and which under past legislation are not liable to ordinary
te entry, it shall and may be lawful for the President to cause such tracts in suit-
legal subdivisions to be offered at public sale to the highest bidder, after public
e of not less than three months, at a minimum price of $20 per acre, and any lands
hen disposed of shall thereafter be liable to private entry at said minimum.

supplementary act of March 3, 1865, it is true, coal-beds actually
ed for commercial purposes anterior to that date do not come under
rovisions of this act, but permission for their entry at the minimum
is granted. With one exception none of the coal deposits of Mon-
come under the provisions of this supplementary act. The dis-

coverers are actually debarred from developing their mines, as a money expended or labor performed in opening them will only serve increase the amount to be paid finally when they are put up at aucti regardless of any improvements they have made or vested rights wh they may have acquired. In addition it must be remembered t years must expire before many of the coal deposits can be surveyed, a during all that time their wealth must remain untouched. This state affairs requires the early attention of Congress.

An enlightened policy of political economy demands the early ext guishment of the government title; possession and title to the coal la in suitable subdivisions and at a reduced minimum price should be g ing to those willing and desirous to open and work them, thereby addi to the industrial resources of the Territory and country at large.

LABOR.

The rates of wages in Montana range from $3 to $7 per day, w exceptional higher rates to experienced miners for difficult work. is not probable that there will be any further material decline until cost of living is reduced by the completion of the North Pacific r road. For the coming season an advance is much more probable, with a moderate supply of water only, the number of laborers in country will be entirely inadequate to the demands of the placers unl reinforced by a heavy immigration from the States.

Some 2,000 to 3,000 Chinese are domiciled in the Territory. Si the completion of the Union Pacific railroad to a point about 200 m distant from the southern boundary has materially decreased the d culty of reaching the Territory, it is reasonable to expect that th numbers will rapidly increase. They are exclusively engaged in pla mining and in the performance of domestic duties, such as cooki washing, &c.

The Chinese work their own placer claims, either taking up abando ground or purchasing claims too low in yield to be worked profita by white labor. The ground thus obtained sometimes turns out to very valuable, but usually they work or rework only what would oth wise remain untouched. Their introduction on paying claims and th competition in the labor market has hitherto been stoutly opposed the whites. They are frugal, skillful, and extremely industrious. F quently maltreated by evil-disposed whites, they rarely, if ever, retali Their quarrels are confined to themselves and are usually the result too much opium. Their status in the industrial system forms one the most important questions which agitate the western communit

Although the contrary is stated to be the fact, I am satisfied, fr careful inquiry, that the Chinese in this Territory are not coolies living in a state of slavery. A portion of their earnings may be retai to refund passage money, but even this I consider doubtful. They se to be their own masters, only associating together for mutual assista

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CHAPTER XLI.

NORTHERN PACIFIC RAILROAD.

The following is a contribution on this subject by W. Milner Robert *esq.*, an engineer who was engaged in different surveys made for t ad, and who is not personally interested in either of the routes now nder consideration:

The precise route of the proposed Northern Pacific railroad has not en determined. The charter of the company defines the limits of the untry in which it may be located to be between the 45th and 49th grees of north latitude; and within this limit surveys and reconissances have been made at different periods by the United States vernment and by the Northern Pacific Railroad Company, under thority given by act of Congress.

In a general way it may be said that this line of railroad is to extend om the west end of Lake Superior, about latitude 47°, to the Pacific cean, about the same latitude, crossing the Rocky Mountains in Mon- na Territory somewhere between latitude 45° 50′ and 47° 10′, striking e waters of the Pacific coast by one prong extending to Puget Sound d by another branch down the valley of the Columbia River, connect- g with Portland, Oregon, and with the ocean.

There is a choice of two principal routes from the east approaching e Rocky Mountains: one following the valley of the main Missouri the Mountains; the other crossing the Missouri and pursuing the val- y of the Yellowstone to a favorable divide separating it from the Upper issouri, and thence along the headwaters of the Missouri by the way Gallatin Fork, to near the Three Forks of the Missouri, and thence up a low summit on the main ridge of the mountains. Some interme- iate alternate routes may also be thereafter examined.

Until it shall be decided which of these general routes is to be selected e exact place of crossing the mountains cannot be designated, the pography being such that different passes will be suitable for the ferent routes; and there is a choice of passes on each.

The most northerly pass likely to be chosen in connection with the ore northerly route, by way of the Missouri and its Sun River or Dear- orn River tributaries, is Cadot's Pass, which is about latitude 47° 10′, hile the most southerly in connection with the more southerly line by e valley of the Yellowstone is the Deer Lodge Pass, which is about titude 45° 50′.

Should a pass be chosen with reference to any line from the east, such hoice will determine the route for some distance westward of the main dge of the mountains, as it is necessary to occupy the valley of some ibutary of the Columbia rising in the mountains. The waters of the ackfoot branch of Clark's Fork of the Columbia are suitable for the ore northerly lines, and the waters of the Hell Gate branch for the ore southerly lines.

All the routes from the Rocky Mountains westward follow some trib- tary of the Columbia and ultimately strike its main valley and pass long it for some distance.

From the point on the Columbia River where it is proposed to run ver to Puget Sound, there is again a choice of routes. The most direct cends the east side of the Cascade range of mountains, attaining an evation of three thousand feet above the sea; descending thence by a long heavy grade to the Sound. The other and longer line continues down the immediate valley of the Columbia to the Cowlitz, and following the valley of that stream, flanks the Cascade range and passes by a low portage over to the waters of the sound at its southern extremity; thus avoiding the heavy and costly ascent and descent of the Cascade Mountain.

The shorter routes proposed may be about 1,800 miles from Lake Superior to Puget Sound; the longer ones about 2,000 miles. Until more extensive and more accurate surveys are made, these approximations will be sufficiently correct.

The region between the great valley of the Missouri and the mouth of the Columbia was first explored and surveyed by order of the United States government, by the celebrated explorers Lewis and Clarke, in the years 1804, 1805, and 1806. Their conscientious and very able report depicts with remarkable fidelity the general features of the extensive region traversed by those indefatigable and intelligent travelers. Of course, their examinations were made without reference to railroads, which had not yet been introduced to the world, but the geographical and topographical information they collected has proved to be highly useful to succeeding surveyors and engineers, who, in search of railroad routes, collated therefrom valuable data for modern railroad reports.

At a much later period, when a railroad across the continent began to be regarded as really practicable and advisable, Congress authorized, about 1853, a survey for a northern line, and Governor Stevens was placed at the head of the expedition. The very complete and elaborate report of Governor Stevens, made in 1853-'54, contains a vast fund of valuable information respecting the geography, topography, geology, botany, natural history, and the climatic peculiarities of the country between Lake Superior and the Pacific Ocean; showing among other important matters that, owing to the warm equatorial currents of water and air impinging against the Pacific coast, the climate in latitude 45° to 48° north, all along the Pacific slope on the plains of the Columbia, and nearly to the crest of the Rocky Mountains, is greatly ameliorated, so that it is many degrees milder than in similar latitudes on the Atlantic coast.

In 1863, by order of Congress, the admirable "military road" report of Captain John Mullan was published. This report contains in detail much valuable data applicable to the investigation of railroad routes, between the waters of the Missouri and Columbia. Captain Mullan spent a number of years in surveying, and in constructing military roads in this interesting region, and also made special railroad surveys, the results of which are given in a very satisfactory shape in his report.

Colonel W. W. De Lacey, who was at one period engaged in the surveys both of Governor Stevens and Captain Mullan, has since spent some years in making additional examinations, and is now residing at Helena, in Montana Territory. He has furnished some useful data, and is still engaged in collecting more, relative to railroad routes crossing the Rocky Mountains.

Very able, and, indeed, exhaustive preliminary reports have been made to the public, and more recently to the Northern Pacific Railroad Company, by Edwin F. Johnson, esq., the company's accomplished chief engineer. The preliminary report published by Mr. Johnson in 1853, nearly seventeen years ago, based chiefly upon the surveys and maps of Lewis and Clarke, and other explorations, and upon correspondence with unprofessional parties partially acquainted with the country, exhibits evidence of a vast amount of careful and intelligent study of the whole subject, when the public mind was yet scarcely prepared to appreciate it; and its deductions touching the probable general character of the Northern Pacific Railroad route have been wonderfully sustained thus far by later surveys and reports. In 1867, the same gentleman made another report to the Northern Pacific Railroad Company, with an estimate of cost upon an assumed line between Lake Superior and Puget Sound, estimated at 1,775 miles. Without recommending any precise route for adoption, that report describes the route on which the estimate was then based, as follows:

"The line thus selected for an estimate of cost crosses, after leaving the Mississippi, the Red River of the North, connecting with the navigation upon it; thence it continues to the Dakota or James River, which it intersects in latitude 46½° nearly; thence the line continues to the Missouri and Yellowstone Rivers, crossing the former in the vicinity of the site of old Fort Clark, and the latter in the latitude of 47⅛° north, nearly, both of which rivers are navigable for steamers for long distances above and below the points of crossing; thence along and north of and not far from the Yellowstone, keeping to the south of the divide which separates its tributaries from those of the Missouri, to near the mouth of the Bighorn River, and thence to near the southern extremity of the Judith Mountains, bearing thence northwesterly between the latter and the Belt or Girdle Mountains, passing near to the Grand Falls of the Missouri, the limit of steam navigation upon the latter for the larger class of river vessels; crossing the Missouri above the falls; thence by Cadot's Pass in the main range of the Rocky Mountains, following the valley of the Cokalahiskit or Big Blackfoot River, diverging therefrom by Landsdale's trail, represented as practicable, through an opening to the valley of the Jocko River; thence down the Clark's River Valley to the Pend d'Oreille Lake; thence southwesterly to the Spokane River, and along the southeasterly side of the great Columbia Plains to the crossing of the Columbia River, not far from the mouth of the Yakima River; thence along the valley of the latter river to its source at the true Snoqualmie Pass of the Cascade range of highlands, as above described, northwest of Lake Kitchelus; and thence to Seattle on the shore of Puget Sound.

"The branch line to Portland in Oregon leaves the main line near the crossing of the Columbia River on the west side, and passes down the valley of that river, as represented, to its terminus at Portland, on the Willamette River, a short distance from the Columbia River."

In the spring of 1869 Mr. Johnson made another report based in part upon surveys which had been made under his direction, running out from Lake Superior for some distance, and eastward from Puget Sound through the passes of the Cascade range of mountains, giving an estimate of cost materially lower than his former estimates and founded on the additional data he had obtained.

In the summer of 1869, Messrs. Jay Cooke & Co., bankers of Philadelphia, having been invited to become the financial agents of the Northern Pacific Railroad Company, engaged the services of the writer as their consulting engineer, in company with others, to examine and report to them on this route of this road. The examinations were made at the most favorable period of the year, during the months of June, July, and August last, and the reconnaissance embraced the route from Puget Sound and the Columbia, crossing the Rocky Mountains, to the Missouri River, at Fort Benton, and also over to the valley of the Upper Yellowstone. Governor Marshall, of Minnesota, Philip W. Holmes, esq., and others made a reconnaissance of the country between Lake Superior and the Columbia River, reporting very favorably; and General Hancock examined the Yellowstone Valley, confirming the previous favorable reports made by General Reynolds, whose report was published in 1868.

According to these, the most recent examinations by gentlemen having the advantage of all the former explorations and reports, the line of "easiest grades and least snow" appears to be one crossing the Missouri at or near the mouth of the Yellowstone; thence along the Yellowstone

Valley to the Bozeman Pass in the Belt range of mountains; thence over to the waters of the Gallatin Fork, down and across that stream, and across the Madison Fork to the Jefferson Fork, and up that valley to the Deer Lodge Pass through the main chain of the Rocky Mountains; thence down the Deer Lodge Valley and the Hell Gate River to Clark's River, and along that valley by Lake Pen d'Oreille; thence across the great, rolling, grassy plain of the Columbia to the Columbia River at or near the mouth of Lewis or Snake River, and thence down the Columbia to the Cowlitz River, one of its lower tributaries; up the valley of the Cowlitz and over the portage between the waters of the Columbia and Puget Sound, and descending gently thence to the sound at its southern extremity, whence the railroad may be carried along either side or both sides of the sound, as may be desired, to any part or parts which shall be selected.

It is not considered that sufficient surveys have yet been made to settle definitely the route; but the writer, after carefully considering the whole ground, and after the personal examinations already mentioned in his report to Messrs. Jay Cooke & Co. of September 25, 1869, presented an estimate of the cost of building the road from Lake Superior to Puget Sound, including the branch to Portland, on an assumed distance of two thousand miles, amounting to $85,277,000, an average of $42,638 per mile, including buildings, sidings, and rolling stock.

It would occupy too much space to give in detail all the information collected by the writer relative to the region of country to be traversed by this line of railroad, yet it is rather difficult to condense it into a very small space, so as to leave it sufficiently intelligible; a few prominent features may here be referred to.

Grades.—The grades across the State of Minnesota and the Territory of Dakota to the Missouri River will be very similar to those on the other finished railroads south, passing from Chicago to Sioux City, Council Bluffs, &c.; undulating within the limit of forty feet per mile, although it may be deemed advisable at a few points for short distances to run to a maximum of fifty-three feet per mile. Beyond the Missouri crossing, along the valley of the Yellowstone to near the Bozeman Pass, there is no known reason for assuming higher limits. In passing Bozeman summit of the Belt range, and also in going up the eastern side of the Rocky Mountains, it may or may not be found advisable to adopt a somewhat higher gradient for a few miles. The highest ground encountered between Lake Superior and the Missouri River at the mouth of the Yellowstone is only twenty-three hundred feet above the sea, the low summit of the Rocky Mountains is but little over five thousand feet, and the Bozeman Pass through the Belt range is five hundred feet lower. The height of the country upon which the foregoing estimated line is traced may be approximately stated thus: Beginning at Lake Superior, going westward—

	Miles.	Average height in feet, above the sea.
To Dakota Valley	300	1,[illegible]
To Yellowstone River	300	2,[illegible]
Along Yellowstone	400	[illegible]
To Flathead Valley	300	3,[illegible]
To Lewis or Snake River	200	[illegible]
To Puget Sound	500	[illegible]
Lake Superior to Puget Sound	2,000	

not probable that any main trunk line across the continent, or of
length elsewhere on the globe, will present so small an aggregate
d fall; and there will be but few points where changes of direc-
ay not be effected with gentle curvature.

e need be but two principal summits, whether the more northerly
southerly line be chosen; while the bulk of the line will consist of
rades and long tangents, on which passengers and freight can be
y transported.

o.—There is evidence enough to show that this line of road on
ieral route described will, in ordinary winters, be much less in-
red with snow where it crosses the mountains than are the passes
e southerly points, which are much more elevated above the sea.
fference of five to six degrees of latitude is more than compen-
by the reduced elevation above the sea level, and the climatic
f the warm ocean currents from the equator ameliorating the
s from the Pacific to the Rocky Mountains. An examination of
file of the Union Pacific and Central Pacific lines, between Omaha,
Missouri River, and Sacramento, California, a distance of seventeen
d and seventy-five miles, shows that there are four main summits:
an Summit, on the Black Hills, about five hundred and fifty miles
maha, eight thousand two hundred and thirty-five feet above the
spen Summit, on the Rocky Mountains, nine hundred and thirty-
les from Omaha, seven thousand four hundred and sixty-three
ne at Humboldt Mountain, about twelve hundred and forty-five
om Omaha, six thousand and seventy-six feet; and one on the Sierra
a, only one hundred and five miles from the western terminus at
ento, seven thousand and sixty-two feet; while from a point west
yenne, five hundred and twenty miles from Omaha to Wasatch,
undred and seventy miles from Omaha, a continuous length of
ndred and fifty miles, every portion of the graded road is more
x thousand feet above the sea, being about one thousand feet on
g distance higher than the highest summit grade on the Northern
railroad route, while for the corresponding distance on the
rn Pacific line the average elevation is under three thousand feet,
e thousand feet less. The highest summit on the Northern Pacific
s about three thousand feet lower than the Sherman Summit on
ion Pacific line. The profile also shows that on the Union Pacific
or nine hundred continuous miles from Sidney westward, the road
average height of over five thousand feet, whilst the lowest spot
distance is more than four thousand feet above the sea; whereas
Northern Pacific route only about sixty miles at most are as high
thousand feet; and the corresponding distance of nine hundred
xtending from the mouth of the Yellowstone to the valley of
River, (including the crossing of the Rocky Mountains,) is on
age three thousand feet lower than the grade on the Union Pacific
hen allowing that an elevation of one thousand feet causes a
e of temperature of three degres, this would make a difference
degrees. There is, therefore, a substantial reason for the circum-
now well authenticated, that the snows on the northern route
ed are much less troublesome than they are on the Union
and Central Pacific route. At the same time it should not be
that there will be no trouble from snow on the northern line; there
es where snow falls to the depth of several feet, and at the highest
o the north of the estimated line, the snows are much deeper
the Deer Lodge Pass; and on the alternate line across the
Alene range, the snow falls also a considerable depth. This is

likewise the case on the indicated cut-off routes from the Columbia River, by the way of Yakima River Valley, through the passes of the Cascade range to Puget Sound. The impression I would wish to create is this: That a line can be located between the valley of the Missouri and the mouth of the Columbia River, and to Puget Sound, which for the greater portion of the distance will not encounter any serious trouble from snow; and that in the passage of the Belt range, between the Yellowstone and the Upper Missouri, in case that route should be chosen, the crossing of the Rocky Mountains at Deer Lodge Pass, and of the portage between the Cowlitz River and Puget Sound, no greater obstacles from snow are likely to be met with than have already been encountered and overcome on roads in the New England States and in the State of New York. It is the general and natural impression in the States that the further north the deeper the snow; but on this line the modifying and controlling influences of the mild and dry climate which pervades the interior along this latitude, combined with the greatly reduced elevation of the range of country to be occupied, and low summits of the Rocky Mountains, tend to confirm the favorable statements of intelligent gentlemen who have long been familiar with the region in question. I cannot hesitate, therefore, while fully appreciating the importance of the matter, to present confidently these views in relation to the probable snow difficulties along the proposed route of the northern Pacific railroad.

Lands.—In the grant of lands of alternate sections on a width of forty miles on each side through the Territories, and twenty miles on each side through the States of Minnesota and Oregon, it is assumed that there may be nearly fifty millions of acres which will become the property of the company. In northern Wisconsin, Minnesota, and in Dakota Territory, the general character of the land along the route, as given in the reports of Governor Stevens, and more recently in the reports of Governor Marshall and Philip W. Holmes, esq., who made a special examination in 1869, is excellent for agriculture. In passing over from Lake Superior to the Missouri, the line crosses the valleys of the St. Louis River, the Mississippi, the Red River of the North, and the James River, which are known to present great natural advantages and to need only a railroad to induce their rapid and profitable settlement; a large portion of these valleys is admirably adapted to culture. Along the tributaries of the Missouri and of the Yellowstone, there are arable valleys; and many portions of the main valleys, where they are not adapted to general agriculture and fine natural grazing lands. Indeed, the entire route from the Missouri River to the Columbia River, including the Rocky Mountains, in Montana Territory, is through a region abounding in nutritious bunch-grass, peculiarly suited to the raising of cattle and horses, and requiring very little artificial shelter for the stock in winter. I must not, either designedly or undesignedly, convey an impression that all of this immense body of land is arable, or that it is adapted to the raising of wheat; there is in the large area embraced in this extensive land grant a great variety of soil and climate, and through the mountain region a considerable portion, if it was not for its mineral wealth, would have but little value. There are tracts where, owing to the general absence of sufficient rains and dews, the land cannot be made to yield well without irrigation. On the other hand, there are numerous valleys of rich land which will yield abundantly at once, without artificial irrigation; and there are many millions of acres of the finest timber in the world. It is, of course, a question of time when this region shall be settled and support railroad business; that time will be reguited wholly by the period when the railroad shall be put in operation. t present, the middle portion along and on both sides of the Rocky ountains, in Montana Territory, is wholly dependent on the gold prouction, which has been very remarkable. Gold exists over a very rge area in Montana Territory; also in Idaho, and parts of Utah and ashington Territories, and Oregon. Gold has been the prime cause f the movement of the people to that once far distant interior, which the pening of the railroad to the Pacific has now brought comparatively ear. Only a few years ago Montana became the theater of the gold exitement, yet already a number of farms are established, and the excellent apabilities of the soil and climate are not mere matters of conjecture, ut of actual proof. Wheat, butter, &c., and nearly all kinds of vegetales, which, until recently, brought fabulous prices all over the gold region, re now but little higher, proportionately, than in the old settled States; his has been effected entirely by the cultivation of farms in Montana Teritory. The fact that the whole of the immense region between the issouri and the Lower Columbia River, embracing the Rocky Mountain ange, is, with trifling exceptions, a superior natural grazing country, is ery significant. All over this territory wild animals have fattened for ges. They must now give place to the domesticated herds and flocks r which this region is so admirably designed; and although, as a rule, ver this wide expanse of grass-clothed hills and plains, there is an nadequate supply of rain, the droughts are never sufficient to destroy he bunch-grass pasture, and the soil is generally excellent, and in many laces very rich, needing only irrigation. There are, however, numerous alleys with perennial streams fed from the Rocky Mountains, containng land of the most fertile character, already improved in various places, nd yielding abundant harvests. Land which, if left without railroad acilities, might be allowed to remain forever a natural pasture, will, hen there are chances for shipment of the products by rail, be put nder cultivation. It should be borne in mind that where there are now nly prairies, subject to continual burnings, trees will spring up and lourish hereafter when these lands become protected by civilization. he growth of trees on the Pacific slope is very rapid.

The junction of all main trunk railroads that may be built eastward rom the Pacific Ocean with the Missouri River, will ultimately prove to e much more important than is yet generally imagined; especially hen the valley of that great river becomes more densely populated. An extensive interchange of products will take place, both eastward nd westward from the river along the east and west lines. The imense valleys of the Lower Mississippi and Missouri, all the way from New Orleans to the upper waters, are yet in their infancy as far as popation, agriculture, manufactures, and general commerce are concerned. The construction of railroads along and across these magnificent valleys will stimulate all of them by the great facilities afforded, and throw a large amount of local traffic upon the east and west railroads.

No main trunk line can enjoy a more advantageous position, in this respect, than the Northern Pacific road, and to a very considerable extent this will apply in the cases of the crossing of the Dakota, the Mississippi, the Red River of the North, and the St. Louis River. The productions of the Red River, owing to the extent and wonderful fertility of its valley, will at once create a remunerative trade on the eastn end of the road. This region, it is well known, is admirably adapted o wheat, and intelligent gentlemen who are familiar with its charactertics have estimated that there are fifty millions of acres of cultivable lands in the Red River Valley alone, which may be profitably devoted to the raising of wheat and other cereals.

Branch lines will undoubtedly be constructed leading from the Northern Pacific trunk along the St. Louis River, the Mississippi, the Red River, the Dakota River, and the Milk River branch of the Missouri. These branches will be met by the Canadian improvements, bringing into this connection the vast regions along Lake Winnepeg, including the valley of the Assinaboine. A branch from the Missouri reaching to Milk River, and up that stream to the great Saskatchawan Valley of Canada, will at no distant day constitute a very important feeder of the Northern Pacific line, opening for that large territory railroad outlets to the navigable waters of the eastern Atlantic coast by way of Lake Superior, and to the Gulf of Mexico by the Missouri and Mississippi Rivers. No public project that can be devised will sooner or better develop that vast territory in Canada, and bring out its value. The summer isothermal line of 70° reaches to the valley of the Saskatchawan, about latitude fifty-one degrees north; the same isothermal line passes through Chicago, Cleveland, and Harrisburg, Pennsylvania, on this continent, and through southern France, Lombardy, and the great wheat growing districts of southern Russia. These important Canadian territories, which, for want of adequate investigation and public consideration, have hitherto been generally regarded as valueless, are destined within a reasonable period to perform an important part in the progress of agriculture and commerce on this continent. Lines of latitude are no longer the sole guides in estimating the climatic characteristics or producing qualities of regions to the north, since experience has shown that the chilling effect of high latitude, so marked on the Atlantic coast, is overruled by the influence of the Pacific Ocean, and, perhaps, other causes not yet thoroughly elaborated or understood.

It cannot be doubted that accompanying, and immediately following, the construction of the line of the Northern Pacific road, hundreds of settlements will rapidly be made in the valleys of the Missouri, Yellowstone, &c., on the east, and in the valleys of Clark's River, Columbia River, &c., on the west of the Rocky Mountains.

With respect to the local trade and travel on the railroad along the lower Columbia, and from the Willamette Valley, concentrating at the city of Portland, Oregon, the population and business are already there, only awaiting the opening of this line to make the western end self-sustaining from the start. I speak confidently on this point from personal observation. In Montana there is already an active, enterprising population estimated at over sixty thousand inhabitants, chiefly men, and all directly or indirectly interested in gold or silver mining. There is every reason to anticipate a continuation and increase of the mining business in this region, which must afford a handsome amount of trade and travel immediately on the opening of the railroad.

Coal has been discovered at so many points along the general route that there can no longer remain a doubt on the subject. The company may rely upon having fuel for their engines and shops at reasonable cost, and the transportation of coal for the general use of citizens, and especially for manufacturing, will become an item of profit.

The cost of this railroad will be less per mile than the average cost of railroads in this country, owing to the rare water facilities, at many points, for the cheap carriage of the iron and other materials required; and the large proportion of easy grading; and the cost of working it, owing to the predominance of light grades and curvature over the greater portion of the distance, and the facilities it possesses most of e way in good supplies of water, wood, and coal, will fall below the verage.

Finally, the position of this line across the continent on the shortest racticable distance between the Pacific Ocean and the great lakes of e Atlantic side, establishes it as one of paramount importance in a ational point of view, the value of which to the government cannot sily be overrated. The facilities it will afford for the rapid and eco-omical distribution of troops, ammunition, and stores for the numerous rts on the waters of the Missouri, the Yellowstone, &c., and along the alley of Clark's River, Columbia River, and Puget Sound, will be valuable for military purposes, and will save millions annually to the ublic treasury. A moderate estimate of the mere money-saving to the untry will show not less than three per cent. on the entire cost of the ad every year, for present military transportation alone, to forts now existence. But more forts will be needed to hold the Indian tribes check as the white settlements shall be annually extended over Indian rritory, a matter which is inevitable, and as certain as the ultimate xtermination or absorption of the Indian race. The opening of this ad will forever settle the question of white supremacy over an area of untry covering at least four hundred and fifty thousand square miles; fficient in extent to make ten states of the size of Pennsylvania.

The Northern Pacific railroad will be a most convenient route for ade and travel across the ocean from Asia and the Sandwich and other ands of the Pacific; for transporting Asiatic products quickly to the ld regions of Montana, and distributing them along the valleys of the ellowstone, the Missouri, the Dakota, the Red River, the Mississippi, d the lake region. It is true that the main or most northerly terminus ill be at Lake Superior, but connections with St. Paul, Milwaukee, d Chicago, &c., are certain to be made, which will put this line in rect communication with the entire railroad system of the United tates and Canada.

The ocean currents of the Pacific are such that vessels from Asia, c., destined even as far south as San Francisco, are compelled to make rthing, which brings them on a parallel with Puget Sound. This is very important fact in connection with the northern Pacific route. is line, with the land grant secured to the company by the govern-ent, possesses great intrinsic value, and will be, as a whole, remarka-y favorable. If judiciously located, honestly constructed and properly ministered, it will within a few years pay a fair dividend on its cost.

These are the general features of the Northern Pacific Railroad route. ny interesting matters connected with the subject could not appro-iately be presented in a paper of this nature and will have to be tained for another occasion.

CHAPTER XLII.

DEER LODGE COUNTY.

This county is rectangular in form; its boundaries being straight lines, **cept a slight projection** in the southeast corner. It is about one hun-ed miles wide and two hundred and fifty miles long. Its northern line **the boundary between** the United States and the British possessions. **e western line follows** down the parallel of longitude 113° 30′ to about **titude 45° 50′, and** then runs in an irregular southeast course till it intersects the parallel of longitude 112°, which it follows up to the British line, covering three and a half degrees of latitude, from 45° 30′ to 49°.

The northern half of the county is on the east side of the Rocky Mountains and the southern half on the western slope, the main chain running diagonally across the county northwest and southeast. The northern half, embracing some of the best agricultural, grazing, and, probably, mining regions in the county, is a *terra incognita* almost utterly unknown to the white man, because it is in the undisputed possession of the Indians, who still indulge in the pleasant pastime of murdering and robbing any luckless wight that they find in it intent on developing its resources and making it of some benefit to mankind. The southern and western portion of the county is sparsely settled by a hardy and thriving people, who are principally devoted to mining pursuits, agriculture, and grazing, for which the county is admirably adapted. This portion of the county is drained to the west and northwest by the Deer Lodge, Hell Gate, and Big Blackfoot Rivers, the northeastern head-branches of the Columbia, and their tributaries. The northeastern portion of the county is drained to the east by the tributaries of the Dearborn, Sun-Têton, Mavias, and Milk Rivers, branches of the Missouri, and partakes of the character of a plateau or plain country, which further to the east degenerates into "bad lands." The Rocky Mountains bend around the southern end of the county like a fish-hook, and, running diagonally through it, pass out near the northwest corner into Missoula County. Along this part of the range are some lofty peaks, and the chain is much broken up. The same is the case at the south end of the county where the dislocation is very great, the mountains rising in jagged and almost inaccessible peaks, some of which are undoubtedly 14,000 feet high, and rise far above the eternal snow-line. In the intermediate portion the range does not rise above the timber line; the outlines are rounded, and those parts not timbered are covered with a luxuriant growth of bunch-grass.

There are many spurs making out in all directions from the main chain, many of them being of equal, or even greater, height. They are mountains of upheaval and not of erosion. Many of the highest peaks are composed of altered sedimentary rocks, which dip at various angles from a very gentle inclination to almost vertical. In some places the granite and syenite protrude and form peaks, but they are excep into fine slabs of all sizes and thicknesses, which show an exquisite ar tional. Some high peaks and ridges are composed of sandstone split rangement of ripple-marks. Limestone of excellent quality is abundant in almost all parts of the county. Coal exists in several places in the county. One bed of unknown extent lies in a basin at the head of branch of Little Blackfoot Creek, near Mullan's Pass. It is supposed to cover at least one thousand acres; was discovered July 16, 1869, by Morgan & Embody while prospecting for gold; is nine feet thick, lying nearly horizontal, with a slight dip to the east. This coal presents a fine glossy appearance; is bituminous, free from earthy or sulphurous substances, and burns in a stove or grate with a clear blaze, leaving but little ashes or cinder. It is about thirty miles from Deer Lodge and twenty from Helena. The owners say it can be mined for $10 per ton, and delivered at the first-named place for $15 more; making the cost $25, and in Helena about the same.

There is another bed about twenty-five miles west of this one and twenty-five miles due north of Deer Lodge, on a branch of the Big Blackfoot River, called Nevada Creek. This has never been opened, ugh it was claimed by some parties several years ago. It is said of the same quality as the last named; horizontal; about eleven thick; very accessible, and of unknown extent. It is probably a nuation of the first-named bed.

other bed of unknown extent and thickness was found in 1867 by parties who were prospecting for gold on Dog Creek, on the Mul- ad, twelve miles northeast of Deer Lodge. It has not as yet been d or tested, timber being as yet so plenty that the want of coal ot been felt. There are also promising indications of coal near Creek and in the upper part of Deer Lodge Valley.

salt springs are known in the county; nor have any artesian wells bored, and I believe none exist in the Territory.

saw-mills driven by water-power are located in various parts of ountry, and one portable steam saw-mill. Lumber sells for from o $60 per thousand, according to quality, accessibility, &c. The y is quite well timbered, probably the second best in the Territory. ula County stands first in this respect.

t a single flouring-mill exists in all this immense county, conse- tly but little wheat is raised, but the quality and yield are both good. and barley are a sure crop when the grasshoppers let them alone; quantities are raised, the yield being fully forty bushels per acre. getables grow to a large size and of most excellent quality, with xception of some of the more delicate kinds, such as melons, pump- squashes, tomatoes, and beans; all of these, however, as well as grow finely in the adjoining county of Missoula, the altitude being lerably less and the nights warmer.

me, once abundant, is now almost exterminated, there being but leer, mountain sheep, or antelope. A few white Rocky Mountain inhabit the most inaccessible peaks. Elk are found in considera- umbers among the densely timbered mountains, where are also a ison or mountain buffalo. All have become exceedingly wary, and uires the utmost skill and patience on the part of the hunter to ed in killing them. Of small game there is the large white hare of ains with yellowish gray eyes, the white hare of the timbered moun- with black eyes, the small brush rabbit, and sage chickens, grouse, ens, ducks, geese, cranes, brants, swans, snipe, plover, curlews, prairie chickens. Of singing birds the lark, robin, thrush, black- and some others are found. Eagles, fish-hawks, various kinds, on hawks, owls, ravens, crows, and vultures are frequently met

h are abundant in all the streams, principally brook and salmon , with considerable numbers of white fish and suckers. Salmon t ascend to all the valleys at present on account of the Kettle of the Columbia, near Colville.

e facilities of communication are excellent, so far as roads are con- d. There are no navigable streams or lakes in the county.

PLACER MINES.

ld was first discovered at Gold Creek, in this county, in 1852, again 58, and still again, in 1860.

ese placers were neglected until 1866, when they were found to be rich and extensive. They are in and among rounded grassy hills northern foot of the Gold Creek Mountains, which are an isolated putting down from the main ranges. The mines, principally hill ngs, will last for many years. That part known to be rich is about five miles square, but it will probably prove to be much more extensive, as all the surrounding country possesses the same characteristics. Water is conveyed to these mines by a number of ditches, a list of which will appear in its proper place. The average price charged is about twenty-five cents per inch for twenty-four hours, it being customary to run day and night during the summer.

The vote of this district in August last was three hundred and thirty-three; but as only about half the adult male population voted, and as the women and children would amount to half as many more, the whole population may be set down at about eight hundred. Wages are from four to six dollars per day without board, according to quality of labor. About one hundred Chinese are in this district. The wages paid them are about half of what is paid white laborers, although their labor is valued at only about ten per cent. less. They are good citizens and are well liked by all, except the Irish, who, true to their interests, are the enemies of all who come into competition with them. The total yield of the above mines is estimated at $3,000,000. They are about at the center of that half of the county lying west of the Rocky Mountains, in latitude 46° 30′ and about 4,100 feet above the level of the sea.

Ophir Gulch, on a tributary of Little Blackfoot Creek, heads in the main range a short distance north of Mullan's Pass, and runs south. It is about twelve miles long and is, or has been, mined the entire distance. Several of its eastern branches, such as Tiger, Carpenter, Prairie, Eureka, and other gulches were rich, and there is a large extent of hill and prairie diggings in the vicinity that will last for some years yet. The mines were discovered in the fall of 1864 by Pemberton, Bratton, Stewart, and others, but no work of any consequence was done, nor was there any excitement about them until March, 1865, when, during a spell of intense cold weather and deep snow, a stampede to these diggings occurred, in which many persons were badly frozen. The town of Blackfoot City was located on Ophir Gulch in May, 1865, and for a couple of years was a place of considerable importance, but the fate of nearly all mining towns overtook it, and it has now dwindled down to a small village, although the mines in its vicinity are far from being exhausted.

Ed. Smith & Co.'s bed-rock flume, three miles below town, in Ophir, was begun in June, 1866; it has a 30-inch bottom; is now one mile in length, and controls the gulch for four miles. Its present cost is $20,000. Thomas E. Pounds & Co.'s bed-rock flume, in Carpenter's Gulch, was started in September, 1866. It has a 26-inch bottom, and is intended to work the gulch four miles. At present it is one mile long, and has cost $14,000. Several other flumes and hydraulic operations are going on, of which I could not get any definite information. The quality of gold here, as well as at Gold Creek, is excellent, coining from $18 to $19 per ounce. The total yield of Ophir Gulch and vicinity has been about $5,000,000. The vote last August was 290, which would give a population of about 500 souls.

Washington, Jefferson, and Nevada Gulches.—They head in the main range just north of Ophir Gulch, and run west into the Big Blackfoot River. A spur of the mountain runs down between each two of them. They were discovered in the summer of 1865, and paid largely in coarse nugget gold. They were shallow and only paid about the base of the main Rocky Mountains, a distance of from three to five miles; lower portions never paid. There is a number of bars on these gulches, which are good, but have not been worked for want of water. Some ditches have lately been dug that will afford a limited supply in future. These mines will last several years yet. Total yield of these gulches, about

,000; quality of gold excellent, same as Ophir Gulch. The vote election was 111. Population about 200, all told.

lellan Gulch heads in the main range, a little north of Washing- uns west parallel to it, and is a small branch of Big Blackfoot Shallow diggings, worked about two miles, near the head; very coarse gold of fine quality. There is still a considerable extent l ground; water scarce; was discovered in 1865, and has yielded 31,600,000. The vote last August was 49. Population about 100

oln Gulch heads in the main range, near Cadol's Pass; runs south g Blackfoot River, and was discovered in 1866. About five miles r portion worked; shallow in the upper part and deep below, the being worked almost exclusively by drifting; water scarce and s bad; will last for years to come; has yielded about $1,200,000. ı August last, 224. Population about 600.

Gulch heads in the spur running down northwest between the ackfoot and Hell Gate Rivers, and runs south into the latter near st line of the county. Was discovered early in the spring of 1866; t twelve miles long. Five miles of upper part worked; very deep; lly worked by drifting; rich in coarse gold of fine quality; will some years yet; water scarce. Deep Gulch is a branch of Bear about four miles long, and all worked to some extent. Deep dig- very rich, but water very scarce. Total yield of the two about ,000. Vote last August, 240. Population about 450.

Creek heads in the spur at the head of Bear and Deep Gulches, ns north into the Big Blackfoot River. It is about 10 miles long; per five miles mined; water scarce. Many rich dry gulches are vicinity, but water cannot be had. The mines in this vicinity will me years yet. Elk Creek and vicinity have produced about 0. Vote in August last, 67. Population about 100.

lerson Gulch is a tributary of Flint Creek, about fifteen miles above uth. It was discovered September 16, 1865, by Joe Henderson rty. In 1866, about 75 men worked in the gulch, and although claims were opened, about $30,000 were realized. In 1867, 175 ere employed, and took out $120,000. In 1868, 125 miners took ut $100,000. In 1869, about 80 men worked; the yield was about , water being very scarce. In ordinary seasons it is quite plenty, eing several ditches of good capacity. Total yield, $300,000. ı August last, 59. Population about 100 in all. These mines will ny years yet. Gold, fair quality and fine.

etown is on a small branch near the head of Flint Creek. The re of small extent and nearly worked out; they are supplied with y a ditch. These mines were discovered in 1865, and have about $40,000. Population about 25. Vote of Georgetown and ombined, 37. Population of Cable about 40. Poor quality of

h Gulch is situated near the southern line of the county, a tribu- Big Hole River, and on the east side of the main range. It is ve miles long, runs southwest, and has been and is being worked le length; shallow diggings. First Chance Gulch puts into it; t three miles long, also shallow, and worked the whole length. id largely. The main gulches are about worked out, but there e extent of side gulches, bars, and hill diggings, that will last s. Water is scarce. The vicinity has yielded about $1,000,000. August last, 117. Population about 200. The district was discovered in spring of 1865 by a party of French Canadians. Gold of fi rate quality.

German Gulch is on the head of the middle fork of the Deer Lo River; is about six miles long, and was discovered in the fall of 186 a small party who were returning from Kootenay. Among them Fred. Brown and Ed. Alfield. The mines are deep, rocky, and har work. They are generally worked now by bed-rock flumes and hyd lies. The water was scarce this year; in ordinary years plenty is plied by several ditches. These mines will last for many years to c Estimated yield, $3,800,000. Gold is of extra good quality. Vot August last, 82. Population, as estimated by a resident, 250. gulch runs north, and is on the west side of the main range.

The following mines and camps are located near the head of Deer Lodge River:

Butte City.—This camp was discovered in 1864 by G. O. Humph and William Allison; it consists of a number of gulches, (most of t dry,) and covers an area of about two square miles, almost all of w will pay to work, and portions of it are quite rich. The water used mining is supplied by ditches, as follows:

No. 1. Owned by Humphreys & Allison, and built by them in 1865 from Silver Bow Creek; is about three and a half miles long, ca 300 inches, and costs about $7,000.

No. 2. Owned by Humphreys & Allison; was built by them in 1 and 1867, from Silver Bow Creek and from a branch of North Boul Its total length is about fourteen miles; it carries about 700 inc and costs $21,500.

No. 3. Owned by John Noyes & Co.; was built by them in 1866–'6 supplied by springs on the side of the mountain bounding Silver Valley on the east, is about twelve miles long, carries 250 inches of ter, and costs $9,500.

Price of water in 1867, 87½ cents per inch for 24 hours.
Price of water in 1868, 62½ cents per inch for 24 hours.
Price of water in 1869, 62½ cents per inch for 24 hours.
Price of labor $4 to $6 per day of 10 hours.
Number of miners employed in 1867 about 260, for four months.
Number of miners employed in 1868 about 140, for three months.
Number of miners employed in 1869 about 50, for two months.

The amount of water sold was about in proportion to the numbe laborers employed, taking as a base of calculation the amount recei by Humphreys & Allison from two ditches in 1867, viz: $20,800.

Yankee Doodle and Pilgrim Gulches are located near the head of Sil Bow Creek, which is the north branch of the Deer Lodge. They discovered in the spring of 1867 by William H. Little; are three long, and pay from $6 to $10 per hand for about two months; al entirely dry this season.

Rocker and Silver Bow, discovered in 1864 by Frank Ruff, Peter ter, and Bud Barker, are about six miles in length along Deer Lo Creek. They embrace a large number of dry ravines and prairie gings on the south side of the creek, which latter cover five or square miles, and are supplied with a limited amount of water fr Divide Creek, through the Rocky Mountain Ditch Company's dit which was constructed in 1866 and 1867; is about fifteen miles and costs $16,000; also through Barnard & Company's Ditch, built L. A. Barnard & Co. in 1868–'69, starting at Divide Creek. It is ab eighteen miles long, and costs $20,000.

Black Tail is a small tributary of the Upper Deer Lodge, ab welve miles southeast of Butte. It was discovered by William Chinn, 1867; pays well, but has very little water.

Basin Gulch, situate south of Butte, is a tributary of the Upper Deer odge, is six or seven miles long, and was discovered in 1866 by George opple and brother. It pays from $4 to $10 per day to the hand.

Oro Fino Gulch, discovered in 1865 by Peter Brown, is about two iles long, with an extensive area of bar and dry gulch diggings on ther side. It is located north of Rocker, pays well, but has very little ater.

The foregoing constitute and are embraced in the Silver Bow Basin, Upper Deer Lodge Valley.

Highland, a tributary of Jefferson River, rising on the north side of ed Mountain, was discovered in July, 1866, by Coleman and brother d Crawford. It is about four and a half miles in length, only a portion which is mined. Parts of it are very rich, and the gold found there said to be .970 fine. It is on the east side of the range, near the uthern corner of the county. The best gold coins over $20 per ounce. The gold from Silver Bow, Butte, and Rocker is the poorest, and ing largely mixed with silver, it is only worth $12 to $16 per ounce. The estimated yield of Butte, Silver Bow, Rocker, Highland, and jacent small gulches and placers, has been $4,000,000. The vote of Silver Bow in August last was 83; of Butte, 87; Rocker, ; Highland, 101; total, 337. The population of all combined is about souls.

Prairie Gulch, Uncle Ben's Gulch and vicinity, lie on the west side of eer Lodge Valley, into which they run to the east. They were discov- ed in the spring of 1868, by Frederickson, Moss and "Uncle" Ben Pricer. hese gulches are scarcely developed, yet, owing to the great scarcity of ater, they will probably prove extensive, and will last for several ears; they have yielded about $50,000. The vote last August was 42. opulation about 75.

Cariboo and Boomerang Gulches and vicinity are tributaries of Deer odge River, head in the main range and run west. They were discov- ed in the spring of 1867. The mine portion is about three miles in ngth; but it is as yet unknown for what distance they carry gold. Water is very scarce, and is supplied by ditches. The diggings have id well for the work done. The total yield is about $80,000. The e in August last was 21. Population about 40.

ow Shoe, Dead Wood, and a cluster of small gulches lying east of ir and Carpenter, have been and are still rich, but have always worked to very great disadvantage, owing to a scarcity of water. proper facilities for working they would undoubtedly pay largely. e yielded about $200,000. Vote in August last, 12. Population t 30.

ecapitulation.—The total gold yield of the county has been at least 270,000; the total silver yield of the county has been at least $100,000, last all from Phillipsburg.) The official vote of the county last ust was 2,283, but it being a dry year a large number of voters were nt prospecting, hunting, &c. The population is about 8,500.

QUARTZ MILLS AND LODES.

e thousand five hundred and thirty-four quartz lodes are recorded in county, but a large portion of these are the veriest "wildcat," and of remainder but very few have received any development tending to show their permanency or value. Many, however, would pay well properly worked even now, and a large number will be remunera in a few years, when the cost of living, labor, and machinery has come less.

The James Stuart mill at Phillipsburg, built in 1867 for silver o is a stone building; engine, 50 horse-power; boilers, 40-inch diam and 20 feet long; runs ten stamps, 650 pounds each; six Wheeler p 4 feet in diameter, and three concentrators, 8 feet in diameter; sta and pans are geared to make from 60 to 75 drops and revolutions minute. Capacity from 12 to 15 tons per twenty-four hours, accor to quality of ore. It has crushed about 1,000 tons of quartz in all, w yielded about $100,000. The rock worked was principally cropp and ore taken from near the surface. The mill is now idle, awaitin pairs of crank and cylinder. It cost, all told, about $75,000, currency, is considered the best mill in the Territory. It is situated in Flint C district, which first became generally known in the winter of 1866. district seems to be a basin of stratified rock on the north side of Gold Creek Mountains. The principal explorations have been ca on by a St. Louis company, on what is known as Comanche Hill. F their workings, a shaft 100 feet deep, and a tunnel 200 feet long, bes some considerable stopings and inclines, it appears that the kern the hill consists of stratified rock, chiefly limestone, partly meta phic in character, and all probably highly magnesian. These st each from 2 to 10 feet thick, strike east and west and dip north int hill at an angle of about 30°. In the planes separating them the o found. It consists principally of black sulphurets of silver and silver ores with quartz and calcspar as gangue. The ore is not r larly distributed throughout the entire plane separating two g strata, but occurs in nodules, varying from 1 to 5 feet in thickness, in masses of from 1 to 500 tons. The seam—if it can be so prop called—then narrows down to a mere line of separation between the layers of limestone. The extraordinary anticipations in reference to manche Hill have not been realized. A large mass of croppings, mated at several thousand tons, covered the brow of the hill. This was spangled with black sulphurets, and was supposed to be good ore. Upon being taken down it was found they consisted of limest merely superficially covered with ore, and a small portion of which paid for reduction. Evidently, in this case, the usual order was rever and the slight incrustation of ore rendered the limestone less dest tible than the surrounding country rock. The question of permane and returns will depend upon the size and frequency of recurrenc these ore bonanzas. The question cannot be said to be definitely tled as yet.

A large amount of work has been done to the east of Comanche on the Comanche extension, and the Romley and Bugher Lode, ari from a lawsuit, relative to identity, which was decided in favor of former. At what was called the discovery of the Romley and Bug a body of silver ore, some twenty to thirty feet in width, has b uncovered. That portion of the ore, with heavy spar as gangue, is hig argentiferous; the pure quartzose portion, forming the principal part the contrary, was not sufficiently rich in silver to submit to the oner charges of custom reduction. On the Comanche extension a large b of silver ore has been lately discovered, with threads of native sil visible in considerable quantities. The Poor Man's Joy was one of lodes that first attracted attention in the district. An open cut has b about two hundred feet long, uncovering the vein and showing hree to six feet of quartz. The vein seems to dip at a very small Some of the ore, undoubtedly selected, was shipped to smelting in New Jersey, and Berlin, Prussia, and yielded from $300 to per ton.

little work has been done to venture an opinion as to the character vein. The ore contains a considerable percentage of lead, and practicable for milling. The proprietors propose to put up an air ntrator this winter, to concentrate the ore as much as possible, and o ship it to eastern or European smelting works.

rge number of other lodes have been discovered, but very few of were worked to any considerable extent. They seem to be mostly in England are technically termed "flat veins"—bodies of ore ing stratified rock, and appear to be formations analogous to those ite Pine—with this difference that the strata and ore dip at a lerable angle, and are more confined to their respective seams.

Creek, a deep but narrow gulch, divides the district into two All the lodes in the western portion contain a large percentage d, and some of the ore consists of pure argentiferous galena. No pt at their reduction has been made. Although the affairs of Flint during the past year have been under a cloud, there is every ct that ere long this district will form a prosperous mining com- y. The mill has lately changed hands, and those interested in the t confidently expect the most brilliant results.

Hervey mill is located near Georgetown. It is a steam mill of tamps, driven by a 25 horse-power engine; the whole in a log ng; cost $15,000 to $20,000, currency. Has crushed a consider- mount of quartz from the Minnesota lode, and some others, but not make it pay, although the ore assayed well enough to pay a ome margin if it could be saved. There are many lodes in this t; some of them are large and well defined, and will pay when &c., become cheaper.

Ewing mill is also located near Georgetown. It is an 8-stamp ropelled by a 40 horse-power steam-engine; wooden buildings; ushed ore from several lodes; did not pay; idle now.

Hanauer mill, located near Cable City, is the second best in the . It was built by A. Hanauer in 1868, and contains four batteries stamps, (weight 490 pounds each;) drop 9 inches; speed 75 drops inute; power, 30 horse-power steam-engine; capacity 35 tons per -four hours; original cost of machinery $20,000; cost of erection— use, 35 by 55 feet, engine house, 18 by 55 feet—$20,000 more. The ery was built by Gates, of Chicago. The mill has been running wenty-five days in all, and crushed during that time 625 tons of , which yielded from $5 to $20 per ton. The cost of crushing a s been about $4. At present the mill is idle for want of ores.

drie's mill.—Ray & Hendrie have erected a 10-stamp mill at Butte the past year. The stamps weigh 500 pounds, and are geared 65 times per minute. The mill has done little or no work, and is present; reason unknown.

e very valuable copper mines have been discovered in this district, etty thoroughly prospected. Among the most prominent are the al, Parrott, Gray Eagle, Mountain Chief, &c. The first two are lly considered extensions of the same vein. A shaft has been 5 feet deep on the Original, developing a 3-foot vein. The ore is ally green carbonate and red oxide.

The Parrott has been explored to a depth of 125 feet, and a good vein developed. In the upper zone the copper is in the oxydized form, while in depth peacock ore, remarkably free of gangue, predominates.

A smelting furnace, consisting of a stack furnace, with fan-blowers, &c., was erected to work the copper from these lodes. Five tons of black copper were run out and shipped east for refining. The proprietors state that, at present prices of fuel, labor, &c., they can produce black copper for $40 per ton.

The Nowlan mill, located at Cable City, was erected in the winter of 1857. It has twenty stamps of 472 pounds each, distributed in 4 batteries, and 2 arrastras. The motive power is a 40 horse-power engine, geared to raise the stamps 80 times per minute 7 inches high. The cost of erection was $48,000 in all. The mill reduces 42 to 54 tons of ore in 24 hours, and consumes 3 cords of wood. Cost of reduction is reported at $5, currency. The entire amount of ore reduced is 9,200 tons, all from the Atlantic Cable lode, which yielded $172,000 in gold coin. The mill was erected under a contract with the proprietors of the Atlantic Cable Lode to work 10,000 tons of ore from that lode, at $11 per ton in gold.

Atlantic Cable lode.—This magnificent mine was discovered in June, 1862. From the workings up to date it seems to be a chimney of auriferous quartz in a dyke of limestone. The ore is of a more or less deep red color, on account of a heavy percentage of iron, and very friable. The body of ore strikes nearly north and south, and the ore chimney dips under the limestone at an angle of 18 degrees. A perpendicular shaft was sunk 140 feet deep and a stope level run 246 feet in length. Nearly 10,000 tons were raised in a little over one year, yielding $172,000, in gold. The system of mining pursued is perhaps without parallel for its wasteful costliness and reckless disregard for danger. As the body of ore gradually dipped away, it was followed in its track instead of being attacked by means of shafts and levels. This necessitated frequent rehandling, and made it extremely difficult to secure the workings against caving. Some of the ore was rehandled 14 times. Add to this the extravagant cost of milling, $11 per ton, great expenses incurred to keep down the water, and the consequence was easily to be foreseen. Finally the mine caved, the proprietors failed, and the mill stopped. In the hands of persons supplied with sufficient capital to work it upon moderate principles of economy, the Atlantic Cable will undoubtedly resume its former productiveness with more favorable results to its proprietors.

Miners and Mechanic's Tunnel.—In the vicinity of the Atlantic Cable lode an extensive tunnel is being cut by a hard-working joint stock company, who deserve success. This company was organized over two years ago, and the shareholders, all poor men, proceeded immediately with their work. Two shifts per day have been engaged most of the time ever since in driving ahead the tunnel, while the balance of the company would engage in other work to supply funds. Eight hundred and forty feet in length have thus been excavated. By far the greater part was through earth and loose rock, but the last 150 feet had to be blasted through solid granite, which seems to constitute the center of the hill. A thousand feet ahead of them they expect to tap the Atlantic Cable lode. Several mineral-bearing quartz seams have been passed in the tunnel; none of them, however, have been rich enough to pay for working.

Deer Lodge County ditches.—The following is a list compiled from the

sor's, Mr. J. R. Elwell's, returns, and comprises all those ditches
sell water:

Locality.	Name of ditch.	Name of owners.	Capacity in inches.	Miles in length.	Value.
	Rock Creek	Kohrs & Co	1,500	13	$60,000
	Tom Stuart	Pioneer Co	100	3	1,000
	Pioneer	Pemberton & Co	700	3	10,000
	Keystone	Colonel Thornton	700	5	10,000
	Prouse	Rock Creek Co	450	2	13,000
	Pike's Peak No. 1	Kohrs & Co	400	3	7,000
	Pike's Peak No. 2	Kohrs & Co	300	3	3,000
	Caruther's	George Caruthers	300	3	5,000
	Enterprise	Pemberton & Co	250	3	5,000
	Last Knob	Pemberton & Co	200	2	2,500
	Dutchman's	Meagher & Co	300	2	5,000
t	Tiger	Pemberton & Bratton	600	3	10,000
	Ohio	Pounds & Green	800	15	30,000
	Snowshoe	Kelly & Co	500	3	4,000
	Pryor	Pryor & Johnson	200	3	1,500
	Johnson	Johnson & Co	200	3	3,000
Gulch	California	Thornton & Preston	600	5	20,000
	Bear Creek	Domingo & Co	300	7	6,000
	American	Weir & Co	200	2	2,500
	Moose Creek	Lebeau & Co	150	2	2,000
ek	Mill Creek	P. Golden & Co	700	2	3,500
Gulch	Minnesota	Harris & Co	500	15	40,000
	Beef Straight		300	5	2,000
	German Gulch	Stone & Co	300	4	8,000
d Gulch	Highland		500	5	10,000
l	Blacktail	—— Shoup	500	6	6,000
	Humphrey & Allison	Humphrey & Allison	800	25	40,000
	Noyes	John Noyes	500	5	4,000
	Silver Bow & Rocker	Vanderburg & Co	1,000	3	10,000
ow	Divide Creek No. 1	L. A. Barnard & Co	400	23	40,000
	Divide Creek No. 2	L. A. Barnard & Co	300	15	5,000
	China Ditches—2	Chinese	400	4	7,000
	Oro Fino	Morley & Co	500	6	10,000
Gulch	Eight Mile	Bob Linder & Co	500	8	12,000
	Stonewall		500	12	12,000
gton Gulch	Washington	Kelly & Co	500	12	40,000
	Dalton	P. Dalton & Co	300	3	3,000
on	Henderson		500	4	5,000
wn	Georgetown	Jameson & Co	300	4	3,000
	Oro Fino	J. Allport	500	3	10,000
	Caraboo	J. Allport	200	3	2,500
a	California	Jackson & Co	200 250	3 3	5,000 3,000
n	McClellan		200	3	2,500
r Gulch	Standifer	Wilson & Co	300	6	6,000
ek	Miners'		200	3	2,000
ulch	Prairie Bar	Frederickson & Co	200	3	3,000
n's	Uncle Ben's		250	6	3,000
tals			20,350	279	498,000

ddition to the above, many ditches were built by miners for private
sting in the aggregate probably $100,000 more.

appended table of valuation is taken from the New Northwest:

Comparative table of valuations and taxes, Deer Lodge County.

	Number.				Valuation.			
	1866.	1867.	1868.	1869.	1866.	1867.	1868.	1869.
ltivated	1,760	17,240	30,425	26,400	$20,150	$43,560	$38,845	$66,975
e-stock			5,543		122,610	165,542	244,081	
				1,230				61,265
				752				11,780
				4,942				177,650
				545				4,920
				392				1,235
carriages			386	264			22,710	16,965
s				426			172,150	113,315
merchandising							210,183	209,275
nd credits							208,453	167,865
stock companies								197,200
ue of property					455,891	619,276	1,028,631	1,100,000
tax assessed					1,823	2,477	4,619	14,670
tax collected					3	2,000	3,788	
es collected					4,232	6,990	9,630	*7,503

* To date.

CHAPTER XLIII.

LEWIS AND CLARKE COUNTY.

Lewis and Clarke (formerly Edgerton) County occupies the geographical center of the settled portion of the Territory. Its boundaries are defined by the Sun River in the north, the Missouri River (flowing here from south to north) in the east, the divide of the main range of the Rocky Mountains in the west, and in the south by a spur of the same shooting out towards the northwest. These lines inclose a belt about thirty-five miles wide and one hundred miles long, parallel with the Missouri River.

The northwestern part of the county is a continuation of the Grand Coteau de Missouri, a high level plateau, sandy and arid in nature, and offering little inducement for settlement, except in the valleys of the streams by which it is intersected. The northwestern section, formed by the head-waters of Dearborn and Sun Rivers, is reported to be extremely rugged and inaccessible.

The southern half of the county is a basin between the main and belt range, divided up into a number of beautiful valleys by low intersecting foot-hills. Prominent among this system are Prickly Pear, Ten Mile, Seven Mile, Missouri, and Dearborn Valleys, all of which are excellently adapted for agriculture and stock-raising. The necessary water for irrigation is taken from the streams, and a large number of acres annually yield a bountiful harvest of all the hardier cereals.

Surrounding and in close proximity to these agricultural lands are found the principal gold deposits in lodes and placers.

Here, as elsewhere, the Rocky Mountains scarcely merit their distinctive adjective—rocky. They are remarkable for the gentleness of their acclivity and the absence of rugged, projecting peaks. Not only on the sloping sides, but even at the very summit, with rare exceptions, their granitic kernel is covered by a mantle of soil supporting a luxuriant vegetation of bunch-grass or interminable forests of pine, fir, and spruce. Indeed, few important chains are less rocky and barren of soil.

GEOLOGICAL STRUCTURE.

The geological structure of the county seems to be comparatively simple; at the same time the necessary data for fixing the exact boundaries of the various formations are not yet sufficiently numerous and complete.

The backbone of the main range and projecting spurs consists of primitive rocks, among which, coarse-grained granite predominates, with syenite, gneiss, and occasional dikes of trap and peaks of porphyry as accessories. A trap dike parallel with the most important belt of gold-bearing lodes is particularly interesting, on account of the intimate relations it seems to bear to these lodes.

The lower foot-hills and valleys are made up of limestone, both magnesian and argillaceous, slate and sometimes sandstones. Where they approach the granite they are frequently metamorphosed and considerably disturbed. No fossils have been found in these sedimentary strata, and no definite opinion as to their place in the geological series can be formed. Since the discovery, at several points, of lignite similar to the lignite of the plains, it is perhaps not unreasonable to conclude that the strata of the valleys at least are equivalent formations to those underlying the plains of Colorado and Wyoming, and hence of comparatively recent origin. The explorations necessary in placer mining have thorighly developed the drift and alluvial formations. Along the flanks the main range and its spurs, deep gulches and ravines have been cut it by erosive action continued through countless ages, carrying off the ghter and more destructible substances, and depositing in their place in more concentrated form the precious material of the quartz lodes above. is action is frequently very evident, the gulches being rich to the int crossed by the lodes, and barren above. The characteristics of the avel and alluvium, their relative depth, width, and extent, are of urse as varied as the amount of gold which they contain and which akes them so valuable. Fossil teeth, tusks, ribs, &c., are frequently und in the auriferous gravel. Last Chance has been particularly proic in well-preserved specimens. One of the finest specimens lately tained is a tooth of the *Elephas primogenius*, measuring sixteen inches d weighing twelve pounds, with a part of the jawbone attached. But tle is done towards preserving these interesting relics of the past.

POPULATION AND INDUSTRIAL PROGRESS.

Although the smallest, Lewis and Clarke is one of the most populous, ealthy, and flourishing counties in the Territory. At the last election 585 votes were cast, from which the population may be inferred to be obably about 10,000 souls.

Helena, the principal town and county seat, is situated very near the uthern border in Last Chance Gulch. She owes her rapid rise to rich acer and lode deposits in her immediate neighborhood, and her steady ogress, rather unexampled in the history of mining camps, to her peculrly favorable and central location. The first cabin was erected in the inter of 1864. On the 29th of April, 1869, one-third of the town was deroyed by fire, but a few months sufficed to replace the former frame teneents by substantial stone and brick edifices. In the selection of the te the same error so usual to mining towns has been committed. lthough much better locations abound, the business part of the town s gradually been built up in the gulch itself, thus interfering with the haustion of the placers, and giving rise to much vexatious litigation etween miners and lot owners. Among the industrial establishments ore particularly referring to the mining interest, is the foundery and achine shop of Mr. Hendrie, erected in 1867. This establishment conins one cupola furnace, two forges, trip-hammer, three lathes, moldg room, &c., and all other appointments necessary for the repair of artz mills, and is of the utmost importance in a country so far distant om the industrial centers of the East and West.

The county contains one flouring mill with three run of stones, and n saw-mills with a capacity of cutting daily 120,000 feet of lumber. ven of the saw-mills are propelled by steam.

The gratifying industrial progress of the county will appear from the lowing table obtained from official sources:

le showing the number of acres cultivated, value of improvements, total valuation of property, &c., in Lewis and Clarke County.

ear.	Acres land cultivated.	Value of improvements.	Number of live stock.	Value of live stock.	Value of town lots.	Capital in manufacturing.	Capital in merchandise.	Moneys and credits.	Total valuation of property.
5	11, 412	$38, 333	......	....	....	....	....	....	$1, 320, 386
7	18, 507	....	......	$224, 674	....	....	....	....	1, 836, 554
8	22, 052	$237, 185	6, 397	228, 980	$596, 287	$81, 665	$1, 042, 892	$219, 239	2, 635, 972
9	26, 678	....	......	....	796, 146	....	....	....	2, 943, 960

PLACER MINES.

The known and productive placers of Lewis and Clarke are chiefly confined to the southern half of the county. They occupy an area of about twenty-five miles square. Within this limit nearly all the gulches and foot-hills are known to be auriferous. Some of the gulches have been merely prospected for want of facilities to work them, others have been exhausted, but the majority promise to continue their past productiveness for many years to come.

Last Chance Inlet.—This gulch, containing the most important and productive placer in the county, was discovered in July 1864, and has yielded steadily since that time.

Its two forks, Oro Fino and Grizzly Gulches, head in a spur of the main range, pursuing thence a parallel and northerly course for four miles; they unite about half a mile above the town of Helena and form Last Chance proper. A short distance beyond the junction, the inclosing foot-hills come to an abrupt termination and the bed of Last Chance assumes a width of from 400 to 800 feet for a distance of three miles, until it loses its identity in the basin of Ten Mile and Prickly Pear.

The forks Oro Fino and Grizzly are narrow, deep ravines, with the bed rock from 10 to 40 feet deep. Too much water in the drifts and too little for washing have much retarded the working of the claims and a good deal of ground remains to be worked, especially in Oro Fino Gulch. The upper part of Last Chance bears the same characteristics. Extensive drains are necessary to free the claims from the natural gulch water.

In the central and lower part of the main gulch the layer of alluvium is very shallow, and the claims, with the exception of the deep diggings, are easily and quickly worked out. The extreme lower end, where the gulch debouches into the valley, has all the characteristics of bar diggings. It is now almost entirely worked by Chinese who have acquired title by purchase from former owners or by taking up abandoned ground. They produce a considerable amount of gold, but the individual results are not known.

System of mining.—The nature of the ground does not permit the application of hydraulics, without the preparatory construction of a bed-rock flume. In the shallow claims the pay dirt is shoveled directly into the sluice boxes, and where stripping is not feasible it is hoisted by windlasses. It is estimated that the tailings contain at least $1,500,000 which could be saved by proper appliances. To obtain these and to facilitate the working of the balance of the ground, a bed-rock flume through Last Chance Gulch has been projected, but the death of the projector, Colonel Truett, has delayed the immediate execution of his plans. A careful examination and survey have demonstrated its entire feasibility. In the lower claims, where the gold consists of minute scales, quicksilver is used in the sluice boxes. The gold obtained varies from .904 to .915 in fineness.

Production.—The lowest estimate of the production of Last Chance Gulch, up to 1869, places it at $6,500,000. The yield of the main gulch and forks for the present season will be about $700,000. The gulch itself affords a small amount of water, but it is owing principally to an excellent system of ditches, utilizing the water of Ten Mile Creek, that this indispensable article was less scarce here than in the majority of the mining camps throughout the Territory.

Ancient Channel.—The claims of Taylor, Thompson & Co., Holloway & Lutke, and Getchell, 800 feet in length in Last Chance Gulch, about half a mile below the town of Helena, form a deposit which merits a separate description on account of its peculiar geological features and its wonderful yield of gold, past, present and prospective.

At this point the gulch was originally worked to a depth of from six to ten feet, to what was supposed to be the true bed rock, consisting of a layer of arenaceous cement from three to five feet thick. In setting a string of sluice boxes the stratum was perforated and another body of auriferous gravel exposed. This second deposit is from 35 to 45 feet thick. The enormous quantity of gravel it contains, the facilities which it offers for economical working by the introduction of machinery, and the remarkable uniformity with which the gold is distributed through the gravel, have rendered it exceedingly remunerative to the owners and noted for its gross yield of gold. For the present season the yield will be about $200,000.

In order to illustrate the manner of working these claims, I will select that of Taylor, Thompson & Co. To obtain a dump, a wooden tower is erected in some part of the claim partially or entirely worked out. This tower rises above the natural surface of the ground and some 60 feet above the true bed rock. From the top of the same, a number of inclined planes radiate towards the lower face of the gravel bank. On these tramways the gravel is carried in cars to the top of the tower, there dumped into the sluice boxes and washed over the riffles. The motive power is supplied by a steam-engine stationed in the lower part of the tower. On one of the claims the hoisting is performed by an ingenious combination of whims and cranes.

Only the portion of the gravel beneath the false bed rock is worked in this manner. The stratum of sand and cement of which the false bed rock consists and the gravel and soil above it are first stripped and wheeled off. The second layer of gravel which remains is taken down at right angles with the main gulch. To facilitate the excavation perpendicular slits are cut 40 feet apart. No powder is used, as the gravel is easily attacked by pick and shovel.

Numerous opinions in reference to the character and origin of this valuable deposit have been advanced, but none of them are sufficiently satisfactory to be conclusive. According to the first and most generally received opinion, the bed rock of Last Chance Gulch suffers an abrupt depression, forming a large basin or pot-hole. Under such an assumption it is difficult to explain the formation of a placer deposit of such magnitude and such uniformity by the experience of placers elsewhere. This improbability led a number of practical miners, thoroughly acquainted with the ancient channels of California, to the conclusion that the gravel below the first bed rock has nothing to do with Last Chance Gulch, but is part and parcel of an ancient channel crossing the same at right angles. They have sunk a large number of shafts on the low plateau to the west of the gulch and eliminated a belt about 800 feet wide, the locality of the ancient channel. Every shaft sunk within its limits at a depth of from 50 to 70 feet encounters a large volume of water too great to be overcome by any pumping machinery at their disposal. Several attempts to reach the bed rock by sinking deeper proving abortive, the parties engaged in this enterprise are now running an extensive drain tunnel from a point about two miles distant from the deep claims on Last Chance. They have already completed 2,000 feet and propose to continue this drain tunnel at a low grade until they strike pay gravel.

The gravel in the bed of this old river is different from any other in the neighborhood, being deep red, while that of Last Chance has a grayish color. The ancient channel seems to run about parallel with the Missouri River. To the east it has been traced about 1,500 feet from Last Chance Gulch. It is needless to point out the importance of this enterprise, the almost incalculable amount of gold which a succession to the west and east of such claims as are at present being worked in Last Chance would necessarily yield.

Dry, Bowery, and Michigan Gulches.—These gulches descend from the same range and pursue a parallel course with Last Chance. Dry Gulch particularly has yielded considerable amounts of gold in former times. During the present season but little work has been done in any of them. In the upper part of Dry Gulch there seems to be a deposit similar to the deep claims of Last Chance. For about 2,000 feet no bed rock has been reached, although shafts have been sunk to a considerable depth. Increased steepness of the side-hills has prevented active work in a great measure.

Tucker, a tributary of Dry Gulch, connects the latter with Tucker Basin. The latter is about 2,000 feet square, and, although the supply of water in the most favorable season is very small, has yielded largely. It is crossed by the belt of gold-bearing lodes which undoubtedly have been the source whence all the gulches in this vicinage have derived their material. The surface of the low hill separating the lower end of Last Chance and Dry Gulch has been found auriferous, and is ground on which sluicing is carried on, mining operations being only limited by the encroachments of the town; a gravel channel, crossing obliquely from Dry Gulch to Last Chance, tends to show that at some former time the two gulches united before entering Ten Mile Basin.

Nelson Gulch.—The course of this gulch, starting near the head of Grizzly Gulch, is westward; it empties into Ten Mile. Three bed-rock flumes, one of which is 4,000 feet in length, and has reached a depth of 30 feet, yield excellent results.

Ten Mile.—Placer mining in this gulch is confined to the neighborhood of the divide, from which it takes its course. Two hydraulics on the main fork, and one each on Monitor and Minnehaha, two small forks, have paid well. Little is known in reference to the extent of the placers, which they work. The gulch forms the bed of a considerable stream of water, all of which is diverted by the Big Helena, Yaw-Yaw, and Thompson ditches for the use of the placers surrounding.

Helena.—The upper part of this valley is an almost impenetrable pine forest. As all the gulches entering Ten Mile are more or less auriferous, the bed of the creek itself is generally, and no doubt correctly, supposed to contain rich placers. All attempts to reach the bed rock in the lower part of the gulch have heretofore been frustrated by water. At a great many points in the gulch, wash-tin—"toad's eye,"—is found in considable quantities. No attempt has been made, as yet, to discover the original deposit.

Greenhorn and Skelly Gulches, two westerly tributaries of Ten Mile, have not attracted much attention this season.

Silver Creek is north of Helena. The placers are 50 feet wide, with 5 feet of gravel, and are worked by drifting. The bars have been worked steadily with good results since their discovery. They have furnished employment to 75 miners the past season, and produced $50,000.

In this vicinity are Trust Luck, Iowa, Scratch Gravel, St. Louis, Jeff. Davis, and Trinity Gulches. The bar at the mouth of the latter has paid well, but the gulch itself is very spotted and mostly worked out.

Piegan Gulch, a tributary of Silver Creek, has been the scene of considerable mining operations. The gulch is about three miles long, the pay streak from 30 to 60 feet wide. Nearly all the gold is found on bed rock 15 to 20 feet from the surface. Two hydraulics have been in successful operation, supplied with water by the Piegan ditch. The side bars in the gulch, almost without exception, have paid well. They are worked by stripping and ground sluicing. The gulch has yielded $60,000, and will continue productive for a number of years to come.

Cañon Creek.—This creek is about 15 miles long and situated some twenty miles northwest of Helena. Little work has been done in the present bed, and the gold obtained is derived mostly from the old channel running parallel with the present, but on a higher grade. A small ditch, 4 miles in length, with a capacity of 50 inches, supplies the water from the creek itself. Lop Ear, Virginia, Tarhead, Specimen, and several other small gulches, are tributaries of Cañon Creek. They all contain gold, but as yet have to depend upon their own natural supply of water, which during the best seasons is but very limited, and the past summer has been zero.

Of these Lop Ear has so far proved the most productive. This gulch is about one mile long. The pay streak averages 6 feet in width, with a depth of 8 feet to the bed rock. The gold is very coarse and found immediately on the bed rock. The production this season is estimated at $15,000.

Gravelly Range.—This important and interesting placer deposit intersects Cañon Creek at right angles. It forms the channel of an ancient river; one belonging to a system of hills and valleys far anterior to the present configuration of the surface. Usually, ancient channels take their distinctive features from being buried under the rubbish of past ages, and under hills and valleys distributed according to a new and different order of things. In this instance, instead of the channel being submerged, the denudation of the surrounding country has continued, but in new directions, leaving high and dry as the ridge of a range what formerly was the bottom of a valley surrounded by hills. This ancient channel is known for a distance of 9 miles. Although cut in two by Cañon Creek, it continues on both sides. The channel is 100 feet wide and the gravel from 3 to 50 feet thick. It is supplied with water for working by the Gravelly Range ditch, 12 miles long, carrying 200 inches of water, and constructed at an expense of $15,000. The deposit was discovered in 1867. In the following year it produced about $15,000. During this season no work has been done on account of the utter lack of water. With the amount of water at the disposal of the miners in average seasons, it will require more than five years to work out the channel, and it will undoubtedly produce largely during that period.

French Bar.—These placer mines are situated in the extreme southeastern corner of the county on the banks of the Missouri River. The river at this point makes a bend several miles long. Facing the river are four terraces or plateaus, one rising above the other, named Pilgrim, irginia, Center, and French, and respectively 800, 400, 400, and 1,000 feet in width, and occupying the half circle formed by the river bend. These plateaus are gravel bars, and form an area of about one square mile. rench Bar proper is the most distant from the river and the most important and productive.

It yielded in 1867, $50,000; 1868, $300,000; 1869, $250,000.

The gravel is from 5 to 40 feet thick and will give employment to 500 miners for ten years. These bars are not in the immediate vicinity of higher peaks and ranges, and no good explanation of the source whence they derive their gold is apparent.

The water for washing the gravel is obtained through two ditches, both 24 miles long, with a capacity of 260 and 1,000 inches, respectively. The latter was constructed by Messrs. Tayler, Thompson & Co., at a considerable cost. During the past dry season the ditch only carried one-third of its full capacity.

System of mining.—French Bar is mined by means of hydraulics; the tailings are dumped into the Missouri River. In order to reach bed rock, tunnels from 600 to 800 feet long are driven through the rim rock which raises towards the river. The gold is very fine-grained, and quicksilver must be used in the sluice boxes. The ground is almost exclusively owned and worked by French Canadians.

Valuable gold mines are supposed to exist in the country at and around the headwaters of Sun River. Its comparative inaccessibility, but more particularly the dangers to be encountered from hostile Indians, have so far prevented it from being thoroughly prospected. One party of intrepid prospectors who ventured on its exploration have never been heard from again, and the general belief that they have fallen by the treachery of the red-skins seems well founded.

Ditches.—The gulches containing valuable placers are usually destitute of a natural supply of water, or, at all events, the quantity is entirely inadequate for mining purposes. To supply the deficiency, water must be taken from larger neighboring streams, sometimes over great distances and at great expense. The construction of the ditches by means of which the water is diverted, has been universally remunerative whenever undertaken with any degree of prudence. In the few instances where this has not been the case, it is mainly owing to complications and litigation growing out of disputed water titles.

The following table, though incomplete, exhibits the progress Lewis and Clarke County has made in this direction:

Table of mining ditches of Lewis and Clarke County.

Name.	Owners.	Water taken to—	Length in miles.	Capacity in inches.	Cost.
Big Helena	Truett, Dabler & Atchison	Last Chance	14	800	$110,000
Yaw-Yaw	Truett, Dabler & Atchison	Last Chance	5	2,500	25,000
Taylor, Thompson & Co	Truett, Dabler & Atchison	Last Chance	6	120	4,000
Nelson	Pierson & Spiers	Nelson	4	150	6,000
		Nelson	5	100	5,000
Divide	Ralls & Co.	Quartz Gulch	4	75	3,000
		Greenhorn	2	50	5,000
Piegan	Piegan Manufacturing Co.	Piegan	7	400	2,000
Trinity	Behrn & Co.	Trinity Bar	7	600	15,000
Gravelly Range	E. M. Dunpley	Gravelly Range	12	200	16,000
Park	J. S. Hutchinson	Park	4	100	15,000
Milay	Milay & Co	Cañon Creek	4	50	6,000
French Bar	French Bar Ditch Co.	French Bar	24	260	4,000
Central	Taylor, Thompson & Co.	French Bar	25	1,100	30,000
22 small ditches			44	1,200	48,000
					35,000
Total			167	7,705	329,000

QUARTZ MINES AND MILLS.

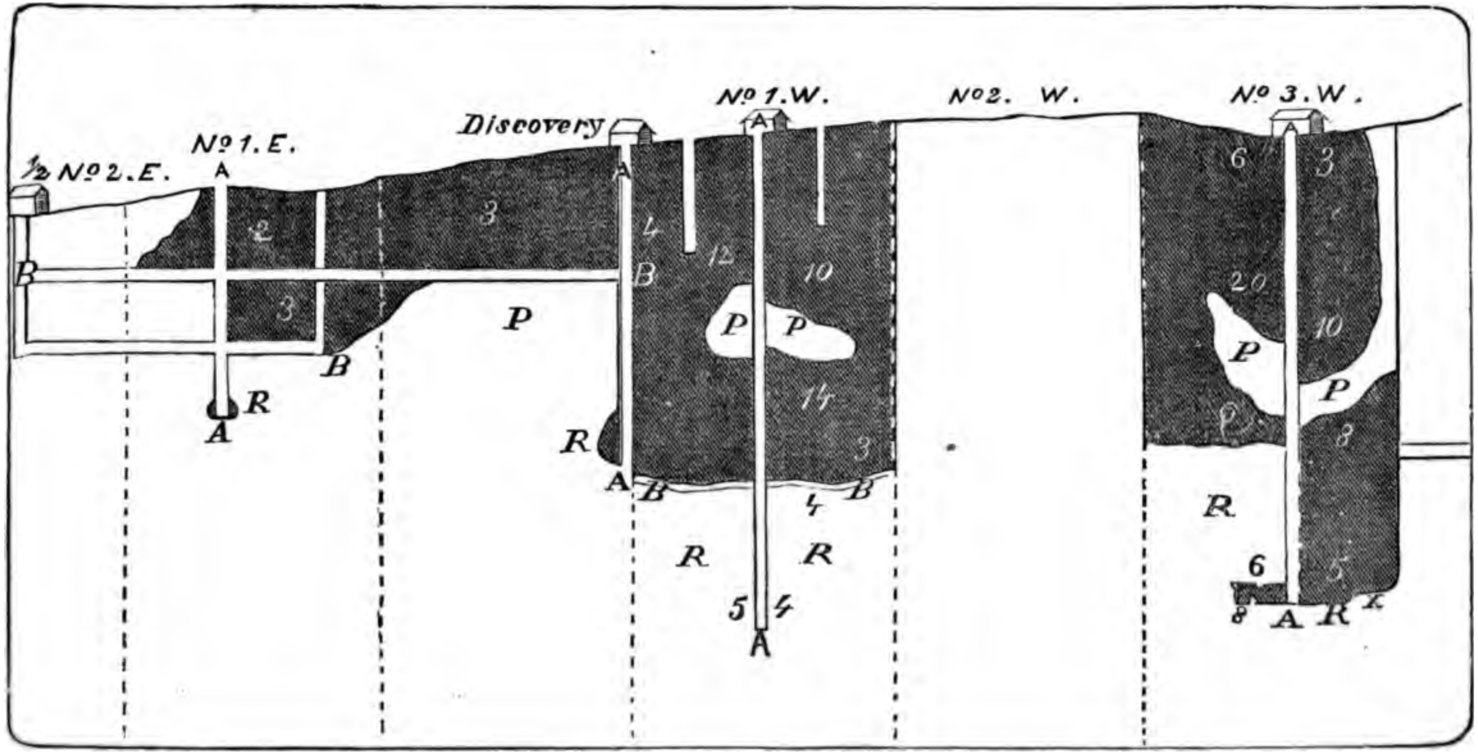
The quartz interest of the county has not suffered the depression which has characterized many other districts during the past year. This is owing to the fact that the Union lode, to which operations were chiefly confined, was sufficiently developed to permit of uninterrupted and successful exploitation. A more rational system has been inaugurated in the working of the mines. These surface indications and gopher les, no matter how promising they may seem, are no longer considered sufficient guarantee to embark in extensive enterprises, and mine ners begin to see the necessity of thoroughly developing their prop- ty and assuring themselves of its permanency before erecting costly ills. Mining like any other legitimate pursuit can only be carried on ccessfully by a close adherence to principles of economy and experience, nd the knowledge of this truth, though dearly bought, is rapidly work- g out its beneficial results.

Twelve quartz-mills have been erected in the county, ten of which re in successful operation. The Gormley and Allen mills are the only nes that are idle; the first for the want of the necessary supply of wa- er for the batteries, the second for want of suitable pay ore.

One thousand six hundred and eighty-eight lodes have been discov- red, staked, and recorded in the county forming a linear vein deposit f over five hundred miles. Many of the veins held under these dis- overies are too narrow and contain ore of too low a grade to be worked t present; but actual developments have proven a large number to be aluable deposits sufficient to form the basis of an extensive, successful, nd permanent mining industry.

Returns and extensive mining operations have been chiefly confined o the gold belt crossing the heads of Oro Fino, Grizzly, Nelson, Dry, nd Tucker Gulches. The parallel veins of which the belt consists are t or near the line of demarcation, separating the limestone strata of he foot-hills and valleys, and the granitic kernel of the range, and probably come under the head of *contact* veins, although at the surface hey are generally entirely in granite. The belt has been traced for a istance of eight miles.

The Whitlatch Union Lode is the most prominent vein in this gold elt. It is better opened, more thoroughly developed, and has yielded larger amount of bullion than any other lode in the Territory. It was iscovered in the winter of 1864, in the park between the sources of Oro ino and Grizzly Gulches, the two forks of Last Chance. It crosses em at right angles, the strike of the lode being being about 85° east. ear the surface the vein is inclosed in walls of coarse-grained granite, ut at a depth of from 100 to 200 feet it passes out of the granite into very fine-grained syenite. Immediately beneath the alluvium the vein very irregular, distorted, and disturbed. It soon assumes a regular ip of 35° to 40° north into the hill and toward the limestone belt, hich it retains for 250 feet. Below the 250-foot level the behavior of e crevice is very remarkable, running, as it does, for over 100 feet hori- ontal and in places rising at an angle of 5° to 20°. The ore in the pper levels consisted chiefly of white quartz, occasionally with a green nt, and a very small percentage of sulphurets; in the lower levels it as assumed a more bluish cast and the amount of sulphurets has rap- lly increased. Runs upon select ore have yielded as high as $65 to $80 er ton, but the general average of pay ore has been $25 in coin with a mall amount of second class rock yielding from $15 to $20. It is not so uch a large percentage in gold as a very regular distribution throughout he fissure, causing but little dead-work, which has placed it at the head f the list of gold-producing lodes in the Territory. There are a number of aults displacing the vein from two to six feet, without, however, inter- ering materially in the successful exploitation of the same. The bottom f the deep inclines and the lower faces have reached the water level nd the segregation of the claims into small parcels is making itself felt. The water is hoisted at present in sheet-iron cars, but ere long more ef- ective machinery will be necessary.



PROFILE OF WHITLATCH UNION LODE.

Scale: 150 feet to the inch. The figures indicate the width of the vein at different points; A A, working shafts; B B, drain tunnel; P P, pillars of poor ground; R R, reserves. The ground of the National Mining and Exploring Company is left blank, as the agent in Montana would give no information as to the workings, and the officers of the company in New York possessed none.

The lode is actively worked by four companies: the Hendrie mine, onsisting of discovery and claims No. 1 east and one-half of No. 2 ast, owned by Mr. C. Hendrie; the Ricker mine, claim No. 1 west, wned by Mr. J. C. Ricker; the Hodge mine, claim No. 2 west, owned by he National Mining and Exploring Company; and the Tatem mine, upon laim No. 3 west, and owned by the Columbia Mining Company. The maner of working these mines, the position of the inclines and levels, the hickness of the vein at different points, the amount of stoping done, nd the position and quantity of reserves will best appear from the acompanying profile and section, and explanatory notes.

The hoisting of the ore in the Tatem and Hodge mines is done by a team-engine; in the Ricker mine by a horse-whim, and in the Hendrie, emporarily by windlasses, it being the intention of the owner to substiute steam-power at an early day. The greatest depth obtained is about 100 feet.

In the latter mine Mr. Hendrie has lately introduced the use of giant powder, and proved it to be a valuable auxiliary in hard rock.

Immediately adjoining in the west on the same fissure is the Owhyee or Parkinson lode. Only one claim has been opened to any extent y an incline some 200 feet deep with considerable stopes on either side. The vein bears the same characteristics as in the Union discovery and ontains a large amount of rich pay ore.

The Park lode is about half a mile still further west. It is either on the same or a parallel fissure. Shafts have been sunk by Mr. Whitlatch nd Judge Tumley, to the depth of 200 feet. The vein preserves all the haracteristics of a true and permanent vein, but the ore is much more ficult to reduce, as sulphurets predominate largely.

The McEntyre, Gain, Walrussia, Wisconsin, and others, are discovries upon the main or parallel seams.

Two miles to the east the gold belt passes through Tucker Basin, and he McLellan, Uncle Sam, Granite Mountain, Winscott, and other disveries, have been made and considerable work has been done. A unnel 280 feet long is being driven in the Uncle Sam Hill but has not et reached the lode. A tunnel of considerable length was run on the ranite Mountain lode, developing a narrow seam containing rich ore. he discovery of the McLellan lode was made immediately in the bed the gulch. The vein is from 15 to 20 feet wide, containing free ld quartz in large quantities. Perhaps in no district in the Territory ould the erection of a number of good stamp mills assure such large d immediate returns as in Tucker Basin.

At Greenhorn the Burdeck mill is successfully reducing ore from the ar Eagle lode. The vein is 8 feet wide, and the ore ferruginous and uch decomposed. It is mined very cheaply at not exceeding $1 per n.

In the valley of Seven Mile, about five miles from Helena, a number argentiferous lead veins have been discovered, prominent among hich are the Sam Gaty and Doc. Steele. The influx of water has tricted developments to shafts 75 to 80 feet in depth. No attempt at e reduction of the ore has been made.

List of stamp mills in Lewis and Clarke County.

Name of mill.	Owners.	Location.	Where manufactured.	When erected.	Cost.	No. of batteries.	No. of stamp.	Weight of stamps.	No. of drops.	Height of drop.	Capacity crushing in tons per 24 hours.	Total No. tons crushed.	Yield per ton.	Cost of reduction per ton.
										In.				
Tatem Mill	Columbia Mining Co.	Unionville	St. Louis	Fall of 1867	$45,000	6	30	650	65	7¼	30	15,546	$25 00	......
Hodge Mill	Nat'l Min'g & Exp'g Co.	Unionville	......	......	30,000	4	20	650	70	......	......	......	......	......
Ricker Mill	J. C. Ricker	Grizzly Gulch	Burlington	Fall of 1865	30,000	4	24	600	50	10	30	25,000	6 to 56	......
Addis Mill	Diamond City Min'g Co.	Grizzly Gulch	St. Louis	1867	20,000	2	10	650	65	8	16	5,000	30 00	......
Tumley Mill	Judge Tumley	Grizzly Gulch	St. Louis	Dec., 1865	20,000	2	10	666	62	11½	15	16,000	28 00	......
Gormley Mill	C. Hendrie	Nelson Gulch	Burlington	1866	27,000	2	12	550	65	10	15	20,000	18 00	$3 00
Hendrie Mill	C. Hendrie	Oro Fino	Burlington	July, 1869	20,000	4	20	550	60	9	25	......	......	......
Allen Mill	Kaiser & Co	Ten Mile	St. Louis	1868	20,000	2	10	650	65	8	......	......	......	......
Blue Cloud Mill	Comer & Co	Blue Cloud	St. Louis	1868	25,000	2	10	650	65	7½	......	500	......	......
Burdeck Mill	Plymouth Mining Co.	Greenhorn	St. Louis	1868	20,000	2	10	500	......	......	......	500	12 00	......

Remarks.—All the above mills are propelled by steam-power and have frame buildings; all have arrastras and settlers. In the Tatem mill, the arrastras are shortly to be replaced by a number of Wheeler pans.

COAL.

The O'Bannon coal mines, the only known deposit, were discovered in the northeastern corner of the county, on the south side of Dearborn River, near the Benton road, and 50 miles distant from Helena. The coal occurs in a bluff 300 feet above the level of the valley, and is, properly speaking, a lignite. There are three layers, 2 to 5 feet in thickness, and 50 feet apart, with an east and west course. At the surface the layers dip at an angle of 40 degrees, but 100 feet back they assume a horizontal position. This deposit has been opened by an incline 110 feet long. It improves materially at a greater distance from the surface, becoming less slaty and decomposed. Considerable quantities have been transported to Helena and successfully used as fuel, for blacksmithing purposes, and in the manufacture of gas. Its importance has declined since the discovery of the coal near Greenhorn, on account of the greater proximity of the latter to Helena. This deposit is situate in Deer Lodge County and contains the same quality of coal as the one described above.

CHAPTER XLIV.

MEAGHER COUNTY

TOPOGRAPHY.

The principal range of mountains in this county is the Belt range, lying a few miles east of the Missouri River, which here runs north. This range is a part of the great system of mountains extending from Mexico to Alaska, the Rocky Mountains, and is connected with the main chain by large spurs, although it is about fifty miles distant from it. It is an immense water shed, throwing all its waters into the Missouri, but in so many directions and at such widely-extended distances that streams having their sources within a few yards of each other debouch into the Missouri at least 1,500 miles apart. Starting as a spur from the main range of the Rocky Mountains, latitude 44° 30′ and 111° west longitude, its direction is almost due north, which it maintains for about one hundred miles until nearly opposite to Fort Ellis. There it gradually trends a little west of north and, at a further distance of one hundred and fifty miles, it is intersected at right angles by the Missouri River. The deep, abrupt cañon thus formed is the "Gate of the Mountains," so called by Lewis and Clarke, and is said to present one of the grandest and sublimest scenes in the world, its sides rising in places perpendicularly from the water's edge to a height of nearly 2,000 feet. Those who have been fortunate enough to pass through this wonderful cañon have been awe-struck by the sublimity of the scene.

The range, continuing to the west, connects with the main range again by the spur having its origin near the headwaters of the Big Blackfoot River, a stream on the Pacific slope, This spur is also divided by an immense cañon similar to the Gate, possessing the same geological structure. The Little Prickly Pear finds its way through this defile to the Missouri. The Belt range thus forms an arm, embracing in its reach the fertile valleys of the Madison, Gallatin, and the Missouri, its summits being crowned with pine forests of unlimited extent, its streams furnishing an abundance of water-power, and its slopes containing gold placers wonderful in yield and extent.

The sides present one abrupt and one gentle slope, similar to main range of the Rocky Mountains, but with this difference, that eastern or Atlantic slope of the latter and the western slope of the l range are in most places quite abrupt, while the opposite slopes of t ranges descend with easy grades into the beautiful valleys of the I Lodge on the west and of Deep Creek or Smith's River on the east. average altitude of the Belt range is about 6,000 feet above the level, though in places it is much higher.

The Highwood Mountains, from twenty to fifty miles south and of Fort Benton, form a cluster of sharp and abrupt peaks, with lying hills and a rugged country little known.

The Little Belt Mountains, south of the Highwood Mountains east of the Main Belt, with which they are connected by spurs, ha general direction, for seventy-five miles, a little north of west and s of east. It is not a very abrupt range, judging from its outlines, tho little is known of it.

The Judith Mountains, northeast of the Little Belt, form ano group but little known—no settlements being near either of the l mentioned ranges.

South of the Judith and east of the Little Belt, the Crazy Mount divide the waters of the Muscleshell and Yellowstone Rivers. They abrupt and very rugged, though in places well timbered, as are all ranges above enumerated. The continuation of the Crazy Mount eastward forms the main water-shed between the Muscleshell and lowstone, and east of the Big Bend of the Muscleshell, where the ra is toned down to outlying hills, it divides the waters of the Miss and the Yellowstone.

The Little Snow Mountains, east of the Judith, are a small, but ab range, in which the feeders of the Muscleshell, below the Big Bend, h their sources.

RIVERS.

The principal river in Meagher County is the Muscleshell. Tak its rise in the southern slopes of the Little Belt Mountains, flowing so a few miles and then east, its waters, augmented by the addition number of clear streams, meet the South Fork (flowing northeaste with its source in the Main Belt Mountains) near the head-waters Deep Creek and Shields' River, or Twenty-five Yard Creek. The fluence of these branches forms a broad stream of clear water, averag eighteen inches in depth and from thirty to fifty feet in width, wit lively, though not rapid current.

A number of streams, some of them of considerable length, hav their sources in the Little Snow Mountains, add their waters to main stream, which flows easterly after the junction of the Middle South Forks, for a distance of about two miles. It then flows eas north and then northwesterly, forming what is termed the Big Bend the Muscleshell, and at a distance of another one hundred miles ent the Missouri three hundred miles below Fort Benton.

As far as the Big Bend the waters of the Muscleshell are beautifi clear; but from that point they assume a different character, becom muddy and sluggish and strongly impregnated with the alkaline through which they flow, sinking altogether in places, standing slimy pools in others, and passing through the formation known as "bad lands," the water partakes largely of the worst qualities of the and is totally unfit for use.

In the spring and summer, when the snows are melting, the Mus adds quite a volume of water to the Missouri, and contributes ›ly dissolved sediment, to which the latter owes its pseudonym Muddy. At other seasons it has only a sluggish current below the Bend.

ıe Judith is perhaps the next river of note. It takes its rise on the hern slope of the Little Belt and in the Judith Mountains. It is a l stream of clear, cold water, running in a northerly direction about ty miles, and enters the Missouri one hundred miles or more above nouth of the Muscleshell. It has several branches of remarkably water, presenting the strange anomaly of containing a great num- f the finest trout, none being caught below the Great Falls of the ouri and very few below the Three Forks.

ep Creek, or Smith's River, of Lewis and Clarke, is another fine m, having its source in the highest mountains of the Belt range and ng nearly parallel to it in a northerly direction for seventy-five , then emptying into the Missouri a few miles above the mouth of River, and near the northern boundary of Meagher County. It has a ber of small branches, the greater part of them rising on the eastern of the Belt range. On some of these valuable placers have been vered, of which more will be said hereafter.

ally the Missouri River itself skirts the county on the west, being estern boundary of Meagher County from Twelve Mile Creek to Creek, a distance of about one hundred and fifty miles. It runs north and receives many tributaries from the east and west. All ributaries entering it from Meagher County contain valuable gold rs, and some of them, such as Confederate, New York, Cave, &c., become famous for their wonderful yield.

VALLEYS.

st of the Belt range, on the eastern bank of the Missouri, and in alleys descending into the same from the divide, there is a con- able area of land, some of which is suited for agriculture, while a portion is well adapted for grazing purposes. Up to the present, ver, they have received little attention, the industrial progress confined to the gold placers.

t of the Belt range lies the beautiful valley of Deep Creek, con- g thousands of acres of fertile lands, admirably situated for irri- n, the numerous streams flowing into the main river (Smith's) ling water in abundance. This valley is truthfully characterized aynolds, (1859–'60,) as "one of the finest upon the continent." astern branch, or Langford's Fork, of Deep Creek, rises on the ern slope of the Little Belt; between its source and that of the leshell there is an almost imperceptible divide. The valley of the leshell presents here the finest grazing lands, and below the , separating the Little Belt from the Main Belt, it widens out into ands of acres of agricultural and grazing lands. As yet no farm- f any extent has been done in either of these valleys, there being w settlements east of the Belt range, all of which are engaged in ing the placers.

the "Judith Basin" the most glowing accounts are given by per- who have been there. A luxuriant growth of grass covers the e valley. Timber is plentiful and game very abundant. Immense of buffalo, much sought after by the different Indian tribes, roam gh this uninhabited section.

e and spruce abound in all the mountains; the valleys are in the main destitute of timber, with the exception of a few cottonwoods on the margin of the streams.

The climate does not differ materially from that prevailing in other parts of the Territory, though the winters are somewhat milder. There is a very slight fall of snow in the Upper Muscleshell Valley and in parts of Deep Creek.

INDIANS.

The settlement of the beautiful country to the east and south of the Belt range, embracing so large a proportion of the area of Meagher County, has not made more rapid progress on account of its being the favorite hunting ground of numerous Indian tribes.

Of the Blackfeet, the Piegans and Bloods find convenient and easy access from the northwest to the unprotected settlements on the eastern slope of the Belt range. They are continually engaged in making raids for the purpose of stealing stock, carrying their depredations even across the range and into the valleys of the Gallatin and the Missouri, the gulches and rugged passes affording them every opportunity for concealment and escape. They have stolen a number of valuable horses this season, and the owners have no recourse but to submit.

The Flatheads, Spokanes, Nez Percés, and Pend d'Oreilles from the west, annually leave their reservation in the Bitter Root Valley, pass through the settlements of Deer Lodge and Lewis and Clarke Counties, and cross the Belt range to the Lower Muscleshell, to hunt buffalo. They pass through Diamond City and the upper part of Gallatin Valley, the bands meeting usually near the South Fork. Difficulties frequently arise from their passage through the settlements, occasioned by a habit of exchanging stock without the owner's permission or of appropriating it altogether.

The River Crows on the northeast confine themselves chiefly to the country bordering on the Missouri River, though they sometimes come into the interior to hunt or make war upon bands of other Indian tribes known to be running buffalo.

The Gros Ventres also come in from the north and east to hunt, trade, steal stock, or make war upon the scattered bands roaming and hunting over the country.

The Mountain Crows on the south frequently send out hunting parties, crossing the valley of the Yellowstone, via Shields River or Twenty-five Yard Creek, or around the Crazy Mountains into the valleys of the Muscleshell, pursuing their game sometimes as far as the Judith Basin.

The Sioux, the dreaded enemies of all the western Indians, coming from the east in war parties to attack, rob, and slay their weaker foes, make incursions upon this country, which are becoming more frequent and formidable every year. It is to be hoped that this state of affairs may not continue. All these tribes are virtually at war with each other, and the almost constant occupation of the country by roaming bands of savages effectually closes it to settlement and civilization.

The establishment of two or three military posts in Deep Creek, Muscleshell, Shields River, and the Judith Basin might have a salutary effect in keeping the Indians out of the country, and render it accessible to white settlers. The fine lands of all these valleys would soon be occupied, herds of stock would be feeding upon the rich, nutritious grasses of the foot-hills, the copper mines could be developed in safety, and the placers worked without that constant dread of incursions and massacres *which* now exists. It is to be hoped that the existing policy of making treaties with savages, who can neither comprehend their meaning nor keep their faith, may soon be substituted by vigorous campaigns against the troublesome tribes, and by placing and keeping them on reservations where they will not interfere with the whites.

COMMUNICATIONS.

The mining communities west of the Belt range are in close connection with the denser settlements of the Territory, and enjoy all the facilities desirable. To the east they are not so good, though the Indians traveling on their light ponies without luggage of any kind find convenient trails to all parts of the country crossing and centering in Upper Deep Creek near the South Fork of the Muscleshell, and in the Judith Basin. The heavy range to cross before entering the valleys east of the Belt range, is the chief obstacle. There is, however, a passable road into Deep Creek, via Confederate Gulch. Shields, or Blackfoot Pass, opening to the Missouri, the Flathead Pass, a few miles further south, leading into the lower part of Gallatin Valley, form a ready communication with the settlements for Indians from Deep Creek and Muscleshell, while Bridger's and Bozeman's Pass, within a few miles of each other, are natural pathways opening into the upper part of Gallatin Valley from the lower Muscleshell and Yellowstone.

Communication via the Missouri River is good during the entire summer season, at least as far as the mouth of the Muscleshell. Above that point the principal if not all the dangers of navigating the Upper Missouri exist. Shoals, sand bars, rapids, and the scarcity of wood, render its navigation, even in the most favorable seasons extremely hazardous, uncertain, and expensive, and in seasons of low water like the present disastrous alike to shippers and steamers. A great part of the freight for Montana has been landed at and below Cow Island, as far down as Fort Peck, and hauled overland from those points to Fort Benton and Helena during 1869; whereas by the establishment of a post at the mouth of Muscleshell, and the construction of a road as contemplated by the government from that point to Fort Ellis, and a branch to Helena, all these difficulties would be avoided, and the certain and speedy delivery of freight at the government posts in the interior and the settlements guaranteed. The government could save enough by the reduction of the freight tariff in one year to pay for the construction of the road, besides opening up a fine country which would soon be developed, and its agriculture and mineral wealth of gold and copper made available.

MINERAL RESOURCES.

In giving a description of the mineral resources of Meagher County, a natural division based upon the topography of the same presents itself. The Belt range forms two sections which, though very unequal in size, are properly considered apart.

MEAGHER COUNTY, WEST OF THE BELT RANGE.

That part of the county remaining between the Belt range and the Missouri River, the western boundary of the county, is merely a narrow strip ten to thirty miles wide and eighty miles long, occupying but a very small area compared to the eastern section; it has, however, yielded nineteen-twentieths of the gold product, and contains nearly the entire population, industry, and civilization of the county.

Confederate Gulch.—Gold was first discovered in Confederate in the winter of 1864–'65. Owing to difficulties in prospecting the gulch it did not receive that immediate attention which its wonderful yield in 1868 proved it to merit. In the spring of this year a drain ditch was completed to bed rock, and ground of extraordinary richness exposed. Before work had been fairly commenced a terrible storm inundated the works and almost completely ruined the drain. When the drain was again reopened in the fall, daily average runs of from $2,000 to $6,000 were made. The bed rock is slate, and the richest deposits are usually found in the riffles formed by its jagged edges.

Water for working the placers is brought from Boulder Creek by a ditch eight miles long, with a capacity of 2,000 inches. The water is carried from the left to the right bank of Confederate Gulch, through an iron pipe 22 inches in diameter and weighing 20,000 pounds. The pipe descends a vertical distance of 400 feet, and rises nearly to the same height on the other side. This ditch and iron siphon were constructed at a cost of $90,000, by Metcalf, McGregor & Co. A second ditch, owned by W. Thomas & Co., ten miles in length, and costing $20,000, carries 1,200 miner's inches. The Eldorado ditch is five miles in length, carries 800 inches, and costs $10,000.

In the lower part of Confederate, King & Gillette have constructed a bed-rock flume about 3,000 feet long and bringing in a depth of 35 feet, at a cost of $60,000. The flume is four feet wide and two and one-half feet high, with a grade of three inches to the rod, and has a good dump. It was feared by some that this grade would not be sufficient to carry off the boulders, and particularly the slate tailings, but actual work demonstrated these fears to be entirely groundless. It is proposed to work all the ground for two miles above with this flume. It was in operation for a short time only this season. Scarcity of water made a suspension of work until next year necessary.

The production of Confederate, up to 1869, was about $1,100,000. No data are at hand from which to form an approximate estimate for the present season.

Montana Gulch and Bar, lying just above Diamond City in Confederate Gulch, have contained exceedingly rich deposits. The pay streak in the latter extended only over 2,000 feet, but as high as $200 to the pan were obtained. The bar was easily worked, there being sufficient elevation to dump, and a larger amount of gold was taken out at a less expense than perhaps in any other set of claims in the Territory.

North of Confederate the western slope of the Belt range is indented by the following gulches: White, Avalanche, Cave, Magpie, Horse, Oregon, and Trout Creek, with its tributaries, New York, Rattlesnake, and Kingsbury.

The bars of White's Gulch have yielded well. In Magpie and Avalanche a number of drains and bed rock flumes have been run, but no great amount has been taken out as yet.

Four miles northwest of Magpie, Cave Gulch opens between low foothills. Some very rich bars have been worked. The gulch is very "spotted," bed rock deep, but paying rich in placers.

New York Gulch was discovered late in the fall of 1865, during the Sun River stampede. It is between four and five miles long, heads in the Belt range and empties into Trout Creek, three miles above the latter's confluence with the Missouri River. Rattlesnake and Kingsbury are tributaries of New York. The placers in this district range from 30 to 60 feet to bed rock. The deep drainage necessary is difficult to obtain, as the bed of the gulch has a gentle grade, and considerable ground ains as yet unworked. The bed rock is slate, and very probably a tinuation of the same formation underlying the vicinage of Confed- e further south.

ew York has yielded about $800,000.

rout Creek, of which New York and several other rich gold-bearing ches are tributaries, is being thoroughly prospected at present. Two npanies are at work with pumps moved by water-power. One of the npanies has reached bed rock at a depth of 90 feet, and obtained tering prospects. The other company have not reached bed rock as ; they are 55 feet down and have two pumps (eight and fourteen hes) at work with every prospect of getting down in a short time. ut Creek, in ordinary seasons, never carries less than 2,000 miner's hes of water. It is about twenty miles long and empties three miles ow New York into the Missouri. It supplies McCune and Eldorado r ditch with water. The former is three and one-half miles long, ries 600 inches, and costs $15,000. The second ditch starts at Trout ek, about a mile below New York, and furnishes Eldorado Bar with ter. This bar is situated about two miles below the mouth of Trout, the Missouri. The Eldorado ditch carries 1,000 inches, and is only e to six miles long; but, owing to great engineering difficulties, it cost in the neighborhood of $100,000. One span across Loup Creek 00 feet long and 152 feet high. A third ditch has been commenced ping Trout Creek, which will make a large amount of ground avail- le.

uartz figured conspicuously in the history of New York during the t two years after its discovery, but at present little is doing in that ection. The following quartz mills were erected, but again removed:

n & Simpson mill, steam	30 stamps.
drie mill, steam	20 stamps.
Leg Mining Company's mill, steam	10 stamps.
el & Wilke's mill, water-power	6 stamps.

everal of these mills were of the most primitive order, with no ac- sory pans, &c., and as the ore of the vicinage comes under the classi- tion of "rebellious," consisting of sulphurets and being accompanied base metals, it may be owing somewhat to this fact that quartz min- operations have not been more successful.

he most prominent lodes are Star of the West and Gold Mountain; ount of work done unknown.

MEAGHER COUNTY, EAST OF THE BELT RANGE.

lacers.—A number of the placers east of the Belt range were dis- ered, worked and abandoned either on account of deep diggings, encroachments of water, little pay, or the general restlessness of ers, who, not content with a moderate compensation for their pay, continually prospecting for something better. From results already ained from gulches once abandoned, but now again reclaimed and ked, there is every reason to believe that a large yield of gold would the legitimate result of a thorough and systematic working of the cers now lying idle.

hompson's Gulch is the principal one now being worked, and was dis- ered in 1865. It was abandoned by the original holders, and after- rds restaked. It rises in the Belt range about twenty miles south of mond City, on the opposite side of the range. It carries 300 inches water to Deep Creek. The gulch is worked for three miles, the pay ak is from 6 to 15 feet in depth and from 25 to 100 feet wide. It is composed of some wash and clay and slate mixed. Heavy boulders impede the working in the main gulch, but the bars on the north side of the gulch are easily worked and pay well. The bed rock is principally slate. About one hundred miners, mechanics, &c., live in the gulch. The gold obtained is coarse and above the average in fineness, the yield up to date being about $50,000.

Indiana Gulch, eight miles north of Thompson's, was discovered in the year 1869. It is worked for three miles, the pay streak being a heavy wash 8 feet deep and 20 feet wide. It is worked by a company of twenty miners known as the House & Pratt Company.

Elk Gulch.—This gulch is five miles farther north, was discovered in 1865, empties into Camas creek, and is four miles long. Prospecting shafts were sunk to a depth of 40 feet and good prospects of coarse gold obtained, the pay streak being principally a fine wash resting on a bed rock of slate. The rapid accumulation of water in the shafts, necessitating the construction of long and expensive drain ditches, compelled the miners to abandon the diggings. They will eventually be worked with success, though not before the outlay of considerable capital.

Thomas Gulch, five miles north of Elk, was likewise discovered in 1865 and abandoned after a limited amount of work had been done.

Benton Gulch, five miles north of Thomas, the pay streak is from 4 to 10 feet deep, of mixed clay and broken slate. The gold is very irregularly distributed and the gulch has not paid well.

Of the above, Indiana, Elk, Thomas and Benton Gulches all empty into Camas Creek.

Beaver Gulch, north of Benton, was discovered in 1865. It empties into Deep Creek. The pay streak is only from 2 to 6 feet deep and 15 feet wide. It is worked by about thirty men and has paid from $3 to $5 per diem to the hand.

It is a fact worthy of note that on both slopes of the Belt range, extensive gold placers have been found, having their fountain-head within a few yards of each other, a fact which seems to confirm the opinion of experienced miners that there are still large deposits of gold in the Belt range, and that a rich reward awaits the systematic and thorough prospector.

Good prospects of fine gold have been found on the Swimming Woman and Flat Willow, tributaries of the Lower Muscleshell, and also in the Judith Mountains; but the placers have never been worked on account of dangers threatening from the ferocity of the Indians.

Ditches.—There are only four ditches in this mining district, all conveying water to the miners of Thompson's Gulch. Two of them belong to Williams & Co., and bring the water from Camas Creek. One is three miles long, carries 800 inches of water, and costs $3,000; the other is two miles long, carries 600 inches, and costs $2,000. A third ditch belongs to a joint company of miners, who use the water in common. It is two and a half miles long, costs $1,500, and brings 140 inches from Birch Creek. Ditch No. 4 was built by Tubbs & McFadden, at a cost of $1,500; it is two and a half miles long, and carries 200 inches from Birch Creek.

Quartz lodes.—The principal lodes east of the Belt range are the copper mines on the headwaters of the Muscleshell; but owing to the difficulty and expense of transportation, they are not worked as much as the extent of the deposits and their richness justify. Danger from Indians is also an important obstacle.

The copper mines of the Muscleshell were discovered in the spring of

1866 by a party of miners, who had abandoned the placers in Elk Creek. In following the Flathead trail, which was afterwards ascertained to cross the principal lead, they observed indications of copper, and upon a close search found rich pieces of ore and some native copper scattered over the surface of the ground. They immediately took the proper steps to secure the valuable mines afterwards discovered near the trail. The discovery of the main lode instigated a more thorough search, and other mines quite as valuable as the first rewarded the prospectors for their labor, and there is no doubt that a more systematic and careful examination may yet reveal still more valuable mines than any found so far. These copper lodes are embraced in a district known as the Muscleshell mining district, which covers an area of about thirty square miles.

The Canada, Boomerang, Ohio, Indiana, St. John's, Granite, State, Oro Fino, and Copperopolis are in every probability situated on the same vein, whose general direction is east by south and west by north. This vein has an average width of 15 to 20 feet, and the gangue consist of heavy spar, quartz, and brown spar, with the different copper ores, viz: sulphurets, red oxide, malachite, azurite, &c. It seems to be a true and permanent vein, nearly perpendicular, and covering the slate formation, which forms the country rock at right angles. The vein matter is not uniform, the ore varying in richness from ten to twenty-five per cent. Occasionally there are zones of exceedingly rich peacock and red oxide ore, ranging from forty to seventy per cent. of copper. The ore of the Nowlan contains red oxide and assays forty per cent. of copper, and sixty per cent. in gold and silver per ton. The Crittenden, Mountain Queen, and Tuscarawas, east of Copper Creek, are also probably true veins. Eight miles to the southeast the Vivian, White Cloud, and De Soto form another cluster of veins.

There is an abundance of timber near the lodes, and the water from the Muscleshell furnishes sufficient power for working blast furnaces, if it should be found advisable to reduce the ores at the mines. At the present prices of labor and the heavy expense of transportation to and from the mines, they will not pay. All the supplies for the mines and their products would have to be hauled to and from Benton, via Helena and Diamond City.

A shipment of three tons of ore, selected from five different lodes, was sent to Baltimore in the fall of 1867. It was merely an experiment, but the results demonstrated the value of the ore when cheap transportation can be obtained.

The average yield was twenty-five per cent. copper. By the erection of proper concentrating machinery, large quantities of rich ore could be shipped to Swansea, Baltimore, or Boston. There must be some cheaper method of transportation, however, before this can be done to advantage. The construction of the road now contemplated by the government from the mouth of Muscleshell to Fort Ellis, would open a way to the Missouri River, whence returning steamers, without freight, could take the ores to St. Louis or New Orleans at a reasonable rate, and the ore could be shipped to such smelting works offering the best advantage.

INDUSTRIAL PROGRESS.

In the absence of the official returns for 1869, I append the table of taxation for 1868. Since that time, every item has materially increased.

Acres under cultivation	12,500
Value of improvements	$11,386

Number of live stock	1,790
Value	$79,756
Capital in merchandising	$52,251
Total valuation of property	$157,405

It is very much to be regretted that so large a proportion of Meagher County is not in better communication with the other territorial settlements, and that up to the present it has only served alternately as the hunting-ground and battle-field of savages. Its natural advantages cannot be too highly prized. Possessed, as it is, of the finest grazing lands in the world, its beautiful valleys attest the fertility of the soil in abundant crops of rich nutritious grasses and wild oats; its countless streams of pure water furnish unlimited power for mills of all kinds; its mountains, covered with dense forests of pine and spruce, are seamed with lodes of gold, copper, and silver.

Game of all kinds abounds. Buffalo, elk, deer, antelope, moose, mountain sheep, grizzly, black, and cinnamon bears, and in Deep and Judith Rivers the finest trout, are plentiful. Aside from these advantages, it is blessed with a salubrious climate, moderately warm summers, and mild winters. It is destined, at no distant day, to contain the happy homes of a large population.

CHAPTER XLV.

JEFFERSON COUNTY.

This county, next to Lewis and Clarke the smallest in the Territory, lies between Madison in the south, Gallatin in the east, Lewis and Clarke in the north, and along its western boundary it is divided from Deer Lodge by the main chain of the Rocky Mountains. The Missouri River separates it from the northern part of Gallatin, and into this river run all the waters of the county. The principal streams are the Prickly Pear and Crow Rivers, the North Boulder, White Tail Deer, Sandy, and Pipestone Creeks.

The first placers in the county were discovered in the valleys of the Prickly Pear and Boulder. The latter region caused quite an excitement in 1864, and much prospecting was carried on at that time. These "rushes" have been repeated almost every year since that time, but mostly without sufficient cause. In fact, the bars in the main stream contain the gold very unevenly distributed, and principally for this reason the operations on the stream have been but moderately profitable. An exception is the Old Bar about eight miles above the Boulder crossing, a locality which has furnished a steady and satisfactory yield. Between the Old Bar and the crossing the bars have been worked to some extent during the last season. It is intended to eventually turn Boulder Creek from its bed in the neighborhood of the upper bars, in order to work the bed along the lower part of this creek. This will open up several miles of undoubtedly very rich ground.

Two bed-rock flumes were constructed in 1868 on Basin Creek, one of the northern tributaries of the Boulder, and since that time these mines have paid quite well. The ground was originally discovered to be gold-bearing in 1865, but owing to want of capital and other causes no extensive operations could be entered into, and the diggings attracted therefore little attention until the summer of 1868. In the same neighborhood several small gulches have been prospected with encouraging results as to yield. In most of them, however, the insufficiency of water was severely felt during last season.

On the Jefferson, a short distance below the mouth of the Boulder, some very rich bars have been discovered. They were worked with water raised from the Jefferson by means of water-wheels and bucket-pumps.

On the Pipestone, part of which runs through Madison County, placers were discovered in 1864. Some of the claims paid well from the beginning, but not until bed-rock flumes and hydraulics were introduced was the gulch made generally productive. During last fall an intense excitement sprung up, caused by the alleged discovery of new and exceedingly rich diggings on this creek. The gold was reported coarse and of fine quality, and so abundant that a yield of $20 per day to the hand was claimed by many. I have not had any later news of this locality, but it is probable that the first reports were rather highly colored and overreached the facts.

Near Beavertown, a few miles south of Jefferson, exist copper placers. The particles of copper being sharp and pointed and held together by portions of half-decomposed quartz, the vein these deposits originated from ought to be near the locality of the placers. I am not informed, however, whether prospecting for the lode has been successful.

The Indian Creek diggings were discovered in 1866. Although they ttracted considerable attention very little gold was produced until last ear, when ditches were constructed to drain the upper part of the gulch, where the bed rock lies very deep. On the west side of Indian Creek, and in the neighborhood of Springville, exist extensive dry gulches and ars. This district suffers very much from the great scarcity of water, and various small ditches have been constructed to supply this want. The most important one is the ditch carrying the water of White Horse Creek to the bars. It is seven miles long, and 300 feet only of this distance are flumes. It holds 200 inches of water, and was finished at a cost of $8,000 in 1867. There is not enough water furnished yet, still the mines have mostly been profitably worked since their discovery in 867.

The placers in the neighborhood of Radersburg on Crow Creek consist of extensive flats and bars. The ground is so flat that enough fall can barely be had to run off the gravel, and the gravel is not rich enough to pay for stripping and shoveling. In June, 1869, the population at these mines was about 150, five hydraulics were in operation, and the supply of water was satisfactory. Forty claims were worked and most of them at a fair profit. Later in the season the supply of water was insufficient. A ditch, seven miles in length, conducts the water from the upper part of Crow Creek to the diggings. It carries 400 inches of water, contains 200 feet of fluming, and was finished by the Radersburg Ditch Company in 1868 at a cost of over $12,000. It has changed hands during last season. The diggings on Wilson Creek, one of the tributaries of Crow Creek, are said to have paid well during last spring.

The principal veins in this county are situated in the vicinity of Jefferson City and Beavertown, and near Radersburg and Springville. The veins of the former locality were discovered at an early date in the history of this region. They are all silver-bearing galena lodes, and much work has been done and considerable money expended on some of them. The developments on the Gregory, made at great expense, were especially highly encouraging, and smelting works were erected to beneficiate the ores. Unfortunately, however, the American hearth was selected as the apparatus supposed to be adapted to the treatment of these ores. The ores carry too much gangue to permit of successful smelting in this furnace, and the experiments proved, of course, unsuccessful. This discouraged the owners so that they suspended operations after having spent much money in experimenting. The furnace was finally sold fo taxes during last year. A second furnace was erected for the purpos of treating the ores from the Alta. The ores from this mine are simila to those of the Gregory, but as those delivered for smelting were bette sorted and carried less gangue, smelting succeeded moderately well though much silver is said to have been lost in the slag. At presen none of these mines are in a very prosperous condition.

The lodes in the neighborhood of Radersburg and Springville are ver little developed, but are said to be rich on the surface. In the forme locality Messrs. Blacker & Keeting have erected an arrastra with tw stamps attached near the Leviathan lode. Eleven tons from the Keetin lode, crushed and worked in the arrastra, yielded $1,300. Fourteen ton from the R. E. Lee, worked in Nave's arrastra, yielded $45 per ton.

CHAPTER XLVI.

MADISON COUNTY.

This county is situated in the extreme southern part of the Territo and adjoins the northeastern portion of Idaho on its southern, Beav Head and the southeastern corner of Deer Lodge County on its wester Jefferson and Gallatin Counties on its northern, and Gallatin Count and the Territory of Wyoming on its eastern boundary line. It is draine by the affluents of Beaver Head, Jefferson, and Madison Rivers.

Gold was discovered first on June 2, 1863, in Alder Gulch, and it reported that up to the fall of 1866 $30,000,000 were taken out from th single locality. Besides this gulch the following have since been four to contain gold:

Ramshorn Gulch, north of Alder. Rich deposits of gravel have bee found beneath what had been formerly considered the bed rock. T gulch has been very productive and will probably be so in future.

Bivin's Gulch has also been profitably worked and is still productiv

Norwegian Gulch and Washington Bar, in the Hot Spring district, we discovered in March, 1864, and have been moderately remunerativ The yield for 1868, however, did not exceed $20,000.

Wigwam Gulch, a tributary to Alder, has been lately discovered. is reported to have yielded rich returns during the last year.

As a general thing the placers of the county have done as well duri the last year as they have before, wherever the great drought of the la season has not prevented gulch mining altogether.

So far as developed, the Everett, Green Campbell lode in Silver St district, takes the lead in quartz mining in the county. Thirteen hun red feet of it have been developed and the lode is now sought to tapped by two tunnels, one to strike it at a depth of 104, the other 320 feet below the surface. These tunnels will drain both the origin location and its extensions. None of the shafts sunk so far are deep than 75 feet vertical, but they show a vein of gold quartz sufficient promising to warrant the contemplated work on the tunnels above me tioned. The average yield of the ore crushed in the company's mill h been $20 per ton.

e Iron Rod, in the same district, is so far considered the next best mine in the county. The ledge is free from water to the lowest reached, 200 feet, and is considered very valuable, having furnished tevens and Trivitt mill regularly with ore during the entire year with fying results. The gold occurs free in the quartz.

lode considered next in value to the above in this county is the tone, in Summit district. It was discovered in the latter part of and is now owned principally by E. Covely. It has been and is uccessfully worked for gold. To a depth of 176 feet, the present m of the workings, the vein has shown great regularity and rich-

foregoing are, of course, not the only gold mines recorded and d in the county; there are many more of perhaps as great and greater value, but future developments must prove them to be they are now supposed to be from the slight improvements made em.

principal silver-bearing veins which have so far attracted attenre found in Brown's district, not far from Virginia City. They are acific, Black, Roma, Louane, and True Silver ledges. They are ing some native silver and decomposed ores, but principally sults. The results reached so far are sufficiently encouraging to the rs to induce them to erect additional machinery for more speedy dvantageous working of the mines. The following mills have been d in the county:

t Spring District.—Cope mill, in Canadian Gulch, erected in 1865. batteries of five stamps each; weight of stamps, 600 pounds each; 12 inches; 50 drops per minute, driven by a 40 horse-power engine; $33,000; capacity, 20 tons in 24 hours. Two arrastras, one amalgar, and blankets complete the works. The amount of quartz crushed ot been kept. Average value of quartz worked, $30. Cost of exon and reduction, $5 each. The mill is now owned by George F. and in operation.

las mill, erected in 1867 by the Midas Company of Rochester, New was built in San Francisco, California, and costs $50,000. It has batteries of five stamps each. Weight of stamps, 600 pounds; 8 inches, and 60 times per minute; capacity, 25 tons per 24 . It is driven by steam-power; contains, besides the stamps, one crusher, two Wheeler pans and one concentrator. No registry crushed; yield and cost of reduction unknown. The mill is now ng.

New York and Montana Mining Company's mill was erected in and can be driven by water or steam-power. Contains four batof five stamps each; weight of stamps, 600 pounds; drop, 10 , and 60 times per minute. Capacity, 20 tons per day; has five pans and four concentrators attached. It is not in operation at it.

Clark and Upson mill of Hartford, Connecticut, was erected in Contains twelve stamps of 500 pounds each. Drop, 8 inches, and es per minute. Capacity, 15 tons per day. It is driven by steam-; contains two arrastras and one concentrator. Cost unkown; not ration at present.

Hobart mill was erected in 1868. It has five stamps, weighing 600 s each. Drop, 8 inches, 60 strokes per minute; driven by water-; capacity, 6 tons in 24 hours; one arrastra is attached. The now crushing ore yielding, on an average, $15 per ton. Number s crushed, cost of extraction and milling unknown.

Sharp's mill, erected in 1869, has five stamps of 600 pounds each and two arrastras. No statistics can be gathered from this mill as no records are kept. It is said to be running at a large profit.

Hall & Spalding mill, erected in 1868, has two batteries of five stamps each; is driven by water-power, and has a capacity of 10 tons per day. The yield, so far, has been $15 per ton of ore crushed. It is not running at present.

The Brooklyn Golden Ore Company's mill was erected in 1867. It is driven by steam-power and has two batteries of five stamps each. Weight of stamps, 500 pounds each; drop, 9 inches, 50 times per minute; capacity, 12 tons per 24 hours. No statistics; mill not running.

Besides the foregoing mills there are three arrastras in Hot Spring district. They are all propelled by water and paying well at present.

It may be stated that the value of the bullion produced in Upper and Lower Hot Spring and Norwegian districts varies from $11 to $20 per ounce in coin.

Mill Creek District.—The Branham mill, with twelve stamps of 500 pounds each, a drop of 12 inches, 40 strokes per minute, and a capacity of 12 tons per 24 hours, was erected in 1865. It is driven by water-power; its yield, so far, unknown, and the average cost of reduction is, as near as can be ascertained, about $2 per ton. The only saving apparatus, aside from the batteries, are tables and blankets. The mill is owned by C. C. and M. Branham, and now idle.

The Bradley arrastra is now running. It has a capacity of 1,500 pounds per day; is propelled by water and works ore from the Branham lode. Yield unknown, but reported good.

Quartz Hill District.—A. W. Whittacker's mill contains three stamps of 400 pounds each, drop, 12 inches, and 40 per minute; propelled by water. Yield of ore crushed, so far, $15 to $18 per ton. It is now running.

Wisconsin Creek District.—In this district there are two arrastras running by water, each paying well. They work ores from the company lode, which yield $23 per ton.

Silver Star District.—The Everett, Green Campbell Mining Company of Cleveland, Ohio, are running a 10-stamp mill with two batteries, four Horn pans, and two settlers. Weight of stamps, 680 pounds; drop 8 inches, and 60 per minute. It is run by steam-power, has a capacity of 18 tons in 24 hours, and cost $25,000. The cost of reduction is $5; the average yield of the ore of the Green Campbell mine, which it is working, is $20.

The Stevens and Trivitt mill is in the upper part of the district. It is inclosed by a frame building and driven by steam. There are twelve stamps of 600 pounds each, arranged in two batteries; drop, 9 inches, and 50 times per minute. It was erected in 1868 at a cost of $30,000. There is a saving apparatus, consisting of blankets and arrastras, attached. Cost of reduction, $5 per ton; average yield of ore from the Iron Rod lode about $50 per ton.

Besides the mills there are six or seven arrastras now running in the district. On an average they are more successful than the mills. Most of them are located in Hell Cañon and propelled by water.

Rochester District.—The Madison County Mining Company's mill has ten stamps and two arrastras with blankets. It was moved from Hot Spring district about a year ago and has been mostly running on ore from the Watseka and Nave lodes. Yield unknown.

Hendric and Woodworth's mill, erected near by, contains ten stamps and is propelled by steam-power. It is idle at present.

Three arrastras, propelled by water, are successfully operated in the district.

The placers lately found in Rochester Gulch in this distrist could not be worked successfully so far, owing to the character of the soil, the scarcity of water, and want of fall in the gulch. Bed rock has only been reached by shafts, but from indications by practical tests it is believed that the gulch can be made to pay handsomely by the expenditure of some capital for ditches.

The Summit District.—The How mill was built in St. Louis and erected in 1866. It contains twenty stamps and two arrastras with blankets. It is propelled by steam-power and inclosed in a stone building. Idle for the want of ore.

The Postlewait and Hawkeye mill contains fifteen stamps, with settlers, arrastras, and blankets. Propelled by steam-power and inclosed in a stone building. It has, of late, made two very successful runs on ore from the Keystone lode, the first of which yielded $16, the second $38 per ton.

The How mill is expected to start up soon on ores from the Polar Star, Idson, and How lodes.

The fine Chilian mill of the Montana Gold and Silver Mining Company of Philadelphia has been idle for a long time for the want of ores, and is under attachment for debts to mechanics and laborers.

The Lucas mill, of twenty stamps, steam-power, building of stone, has been idle for the last two years on account of lawsuits and want of ore.

There are two more mills in the district which, however, have not been erected as yet.

The development of quartz mines in this district has of late been encouraged and greatly stimulated by liberal offers from the millmen to the owners; and the promised reduction in their charges for reduction will undoubtedly hasten the progress of mining matters very much.

The principal placer diggings in the district have so far been in Alder Gulch, which is worked mostly by bed-rock flumes. Messrs. Hall and uthmaid are said to have taken out from their upper flume alone 5,000 during the last year.

Brown's District.—This district is at last assuming the character of a first-rate silver district. The following beneficiating apparatus has been erected so far:

The Conner mill, erected in 1868, has ten stamps, arrastras, and pans. It is driven by steam, and inclosed in a frame building.

The Christenot Chilian mill with barrels and arrastras. It is now idle.

Besides the above, seven arrastras, propelled by water, are now in successful operation and paying well.

Williams and Granite Districts.—One mill and several arrastras are in operation in these districts, with what success I could not learn.

CHAPTER XLVII.

BEAVER HEAD COUNTY.

This county lies in the extreme southern part of the Territory. Its area occupies two degrees of longitude and one and one-half of lattitude. It is bounded on the south and southwest by the Territory of Idaho; on the west by Missoula; on the north by Deer Lodge; on the east by Madison County, Montana. Numerous lofty mountain ranges, beautiful

valleys, clear mountain-brooks, creeks, and rivers abound in this co
The more prominent of the latter are the Big Hole and Beaver Hea
Red Rock, Horse Prairie, and Grasshopper. Red Rock is, und
edly, the most extreme tributary of the Missouri River.

Beaver Head Valley is an extensive tract of good farming land
thinly settled so far. The rancheros have turned their attention m
to stock raising, and from 3,000 to 5,000 head of cattle and h
graze summer and winter on the luxuriant pastures of this v
Had it not been for the destructive pest, the grasshoppers, during
last three years, several thousand acres of land would, undoubtedl
now under cultivation; but, as they destroyed the crops invariabl
farmers have become discouraged. Large quantities of the best
however, are annually cut from numerous natural meadows. A
other valleys in the county, equally fertile and inviting, Horse Pr
and Big Hole, deserve especial mention.

Bannack, the county seat, contains a population of about
souls. It is situated at the mouth of a large cañon on the north si
Grasshopper Creek, ten miles from its confluence with the Beaver
or Red Rock. Three-fourths of the people are engaged in gulch,
and hill mining.

The first mining in the county was done at this place in 1862.
year not less than $600,000 gold were produced. Formerly, the pl
mines were supposed to extend only eight miles down the stream,
they are known to exist also above the town for a distance of ten m
as far as Bald Mountain.

The whole surface, foot-hills, and dry gulches, pay largely, when m
by hydraulics. The only question in this connection is, whether a
cient amount of water can be brought high enough up the hills, to
profitable work on both foot-hills and dry gulches possible.

It was reported at one time that these placers were about exhau
Nothing could be more erroneous than such a statement. It is
that after Alder Gulch, which so easily yielded its tens of thous
Last Chance, Confederate, Black Foot, and other localities were dis
ered, these placers were neglected for three years, and the yield m
urably fell off; but still, there was considerable over wages made du
all that time. A new era in placer mining commenced in 1867,
the larger operation of the Bannack Mining Company and Ditch
pany proved a complete success.

The first mining had been done with the water of the old ditch, wh
constructed in 1863 solely for the purpose of selling water to
miners, had cost $15,000. Its length was fifteen miles. Water
sold up to 1867 at 75 cents per inch, rather a heavy tax for the mi
and discouraging them greatly. In 1867, however, the above
tioned company completed a new ditch, thirty miles in length,
cost of $35,000. The capacity of the old ditch is 2,000, that of
new one, 1,000 inches. Both of them cover over five hundred
of mining ground, and not less than fifteen miles of dry gulches.
average number of men employed by the company during the last
years has been thirty, and the average wages paid by them $6 curr
per day. They control all the water in the two ditches and sell no
miners. In this manner they are enabled to work a vast extent of
ing ground to great advantage, and at the same time to pay hig
wages to the miners employed by them. During last season they h
been running six hydraulics, but in an ordinary season they can
ten. Although this locality did not suffer as much from the drout
other portions of the Territory, because the ditches are brought fr

main creeks, there was still a very perceptible difference between last season and others. The operations of the company have been ly confined to the south and west of Bannack.

hite's ditch receives its water from Grasshopper Creek. It com- ces one mile below the town, and crossing and recrossing the creek tends three and a half miles down stream. The work was prin- lly done by the owners themselves, at a cost of not less than 000. Its capacity is 900 inches. The company employ three aulics and twenty miners. Their income during the last season is to have been highly flattering. It is intended to extend this ditch ng the winter so as to cover a greater surface and richer mines.

ñon ditch has been extended during the last summer from an old , which commences a few miles below White's ditch, and six miles town down the cañon. The cost was $7,000. It now covers a e extent of rich placers. The capacity of the ditch is 600 inches. company had only two months left for mining in the last season, ng which time they employed ten hands. They are said to have e more during this short time of actual work than their ditch cost to build. According to this their future prospects seem to be factory.

oneer ditch, fed by two small streams at the base of Bald Moun- , is ten miles long, carries 600 inches of water, and cost $5,000. vers the foot-hills north of Bannack and eight miles of dry gulches, les many bars and gulches beyond. Two years ago it was unknown these foot-hills contained gold; now the company's property is con- red very valuable. As a six-mile extension of the old ditch was pleted during last season, the company had only three months left ctual mining. The average number of men employed was eight, at er day. In an ordinary season twenty to thirty men can be employed profitably as night and day hands. The company have done well ng last season, but intend to employ Chinamen during the next; ed, it is the general desire of parties operating in this neighborhood troduce this kind of labor in both placer and quartz mines, in order t rid of the past curse of these regions, the extravagant prices paid abor. It is, of course, impossible to say at the present day what ts and results such a change may produce, but everybody is confi- that it will help progress greatly.

HORSE PRAIRIE MINES.

ese mines are located on a branch of the creek of the same name, t thirty-five miles southwest of Bannack.

e bar mining in this gulch has been very profitable during the two years, especially to the Yearian brothers, who have done the cipal mining. They have constructed a ditch of fifteen miles in th, with a capacity of 1,000 inches, at a cost of $15,000. Last sea- water was rather scarce, but ordinarily they can run five hydraulics employ thirty miners. Six dollars in currency per day has been by them during last summer, while formerly they paid $6 in gold. bar belonging to them is one and one-half mile long, and a quarter mile wide on an average. It has paid an average of $20 to the l, which is a larger return than that of any other locality in the ty.

e balance of the mining ground in this gulch is divided into small ests; but all of them have been able to make considerable above wages. Sixty to seventy men have been employed in this camp during the last two years.

BALD MOUNTAIN.

Numerous streams originating on this mountain form as many gulches running from it in all directions. Placers have been found on all of them, but none of them have been worked during last season on account of the scarcity of water. There is ground enough to employ two hundred men; but a large outlay of capital would be required for ditches and hydraulics, before any such number could be profitably put to work. On the east side of Bald Mountain, near Argenta, a ditch is now under construction to bring water into the dry gulches, north of Argenta, which have been found to be tolerably rich in gold.

The Bannack ditch, on the north side of the mountain, is four miles long, has a capacity of 800 inches, and was built in 1862, at a cost of $4,000. It was constructed to sell water to the miners; but the bars, which it covered, are now nearly worked out. It affords now water-power to quartz mills.

Big Hole.—The extensive placers on this stream are worked every year by a few men in the old way. They are generally doing well.

The foot-hills and gulches on the northeast side of the Bannack range of mountains prospect well from a point a few miles below Argenta for a long distance, and here is a field for perhaps the most extensive placer mining in the Territory. It will, however, require a large amount of capital to carry the undertaking into effect on account of costly ditches, which have to be constructed.

Drain ditch, starting two miles below the town, was commenced about two years ago by a company of poor miners. Work on it was mainly carried on during the winter, while during the summer they worked for wages in the mines, or mined on their own account in a small way on some of the numerous unoccupied bars in the neighborhood. They have got now to within a few feet of the bed rock under the channel of the creek, and lately struck a rich streak of coarse gold. Besides doing the work on the ditch they have sunk twelve shafts in the bed of the creek, which have yielded satisfactory returns.

QUARTZ LODES AND QUARTZ MINING.

The first veins of gold-bearing quartz were discovered and worked at Bannack. Almost all of them are contact veins between the limestone and dioritic trap. The hills in the district are usually covered with a thick alluvial deposit; in some cases, however, the surface is left entirely bare and shows outcropping veins carrying gold, argentiferous galena, or copper. In the immediate vicinity of Bannack all the lodes discovered so far contain free gold.

The *Dakota* lode was first discovered in 1862, and in the winter of that year and the following, the first quartz mill, every part of which was home-manufactured, was erected. It was propelled by water-power and had originally six stamps. This number was increased to 12 in 1864. The ores crushed were taken from the Dakota, and at first the operation proved a perfect success. But the irregularity of the vein prevented a regular delivery of ores. There are numerous other veins of a character similar to that of the Dakota in the vicinity of Bannack, the most important of which are the St. Paul, Wadham, Quartz Mill, York, True Flag, Cherokee, Springfield, Mademoiselle, and Golden Gate. Shafts, varying in depth from 80 to 310 feet, have been sunk on all of these, establishing the permanency of the veins in depth. A single exception to this was the Cherokee, which, while worked by the New Jersey company two years ago, suddenly pinched out. It had been exceedingly rich in free gold in the upper part, nevertheless no effort has been made since to find the vein again.

Butterfield & Hopkins's mill, bought in St. Louis, was erected in 1864 at a total cost of $25,000. It is a 24-stamp mill, only twelve of which are erected. The stamps weigh 550 pounds each, drop 14 inches and 45 times per minute, and are propelled by steam power. There is no additional saving apparatus attached, and for mainly this reason the mill extracted, according to tests made on the spot and in New York, only twenty-five per cent. of the gold contained in the ore; it has not been running during the last season. The tailings of the former runs have been saved and it is intended to work them over as soon as the contemplated addition of pans, concentrators, &c., has taken place. This work has been delayed by the death of two of the partners and by the illness of a third one. The owners are principally English capitalists, who, confident of obtaining large profits after the necessary additions have been made, contemplate to carry out their plans next spring.

They have expended large sums of money in developing No. 6, Dakota. Their main shaft is 310 feet deep, and a tunnel 345 feet long has been run to the shaft. In the tunnel is another shaft, 135 feet deep, which passes through 100 feet of pay quartz of a general width of 7 feet. None of it has been stoped out yet. The last-mentioned shaft passes through and below the "caprock," and the vein is found here very regular and standing nearly vertical. Above the vein had always been very broken, and the rich ore occurred in pockets, from most of which selected quartz, yielding as high as $1,200 per ton, could be taken. The dip in the upper parts of the vein was sometimes to the northwest and sometimes to the southwest. Nine hundred and fifty tons of quartz have been crushed from this lode, which yielded over $20 per ton. The average wages paid have been $5 in gold.

The *Montana Mineral Land and Mining Company's* mill is located on the north side of Grasshopper below Bannack. It is a 40-stamp mill and was built by Marshall & Co., of St. Louis, at a reported cost of $16,000. A substantial frame building, 40 by 100 feet, covers it. Both steam and water power, the latter a 36-inch turbine wheel, are available for running the eight batteries of five stamps each. The weight of the stamps is 700 pounds each; they drop 11 inches and 45 times per minute. The capacity of the mill is 40 tons in 24 hours.

Fifteen hundred tons of ore have been crushed by the mill, which yielded $10 in gold on an average. The quartz was taken from different mines in the vicinity. At present, ore from the Wadhams is under treatment, which yields the same returns as the ore crushed before, $10 per ton. The cost of mining and milling a ton of this ore is said to be $4. This mill labors under the same disadvantage as Butterfield & Hopkins's mill; it has no saving apparatus aside from the batteries, and the consequence is that at least fifty per cent. of the gold is carried off with the tailings.

The Hopkins mill was erected this year by R. P. Hopkins. It is propelled by a 15-inch turbine water-wheel, and contains 5 stamps of 700 pounds each, with a drop of 9 inches and 55 strokes per minute. Marshall & Co., of St. Louis, are the manufacturers. It costs $1,500 and the building covering it $1,000 more. The capacity of the mill is 6 tons in 24 hours; 200 tons crushed so far have yielded $10 per ton. The cost of mining and milling is said to be $4 per ton.

The N. E. Wood mill, manufactured by S. W. Bullock, costs $3,000 in New York and its erection $800. Its capacity is 4 tons per 24 hours and the average yield has been $35 per ton. The average cost of mining and milling is said to have been $8 per ton. This mill has no stamps, but consists of a crusher and pan. During the winter of 1867 to 1868 it worked quartz from the Cherokee lode, which yielded an average of $60 per ton. It is now in operation and returns good profits.

THE ARGENTA MINING DISTRICT.

This district is situate fifteen miles north of Bannack at the mouth of the cañon on Rattlesnake Creek. The mines are all located in the foot-hills, which contain a limestone formation with trap dikes similar to that of Bannack. Argentiferous galena is the prevailing ore in these contact veins, which are very abundant, especially in the hills north of Argenta. In a westerly direction they are richer in lead and silver, and deliver excellent ores for the smelting process. Among the mines west of Argenta the Legal Tender is considered the best and richest.

The St. Louis and Montana Mining Company erected furnaces of large capacity in 1865. The original cost was very great, and the large amount of labor necessary for their running prevented a full success. After producing a large quantity of silver in a short time the process was found to be unprofitable and the furnaces were closed.

A. M. Elsler, the discoverer of the Legal Tender, erected another furnace in 1866. Its cost was $8,000 and its capacity about 6 tons of ore per day. During the short time of Mr. Elsler's management it produced over $14,000 in silver and was considered a great success. It is still in good condition, and has been working at intervals up to this fall, but as Professor Rompf, who had the immediate supervision of smelting operations, had gone east for his family, it was impossible to ascertain the exact number of tons smelted, yield, cost of smelting, &c.

The Tootle, Leach & Stapleton furnace was built in 1867, and is a structure similar to the Elsler furnace in every respect. It is now in successful operation and yields satisfactory profits to the owners. G. W. Stapleton is the working partner of the firm, and it is largely due to his energy and economical management that this furnace pays so well. The blast machinery of all of these furnaces is driven by water-power derived from Rattlesnake Creek.

The Wood furnace was built in 1867. The material used for its construction was of inferior quality, so that at the first heating the walls melted down. It was abandoned because there was no fire-clay in the vicinity, at the time, sufficiently refractory to stand the heat. Lately, however, Messrs. Murray and Harrison have found a bed of excellent fire-clay associated with coal a short distance north of Argenta. They have produced a fire-brick which has stood the test and is said to be superior to the fire-brick made in St. Louis, California, and Colorado. The same parties are now erecting a reverberatory to test their brick on a larger scale.

The Faulds terrace furnace was built last year one mile above Bannack to smelt the ores of the Blue Wing district, situate three miles northeast of Bannack. It costs $8,000 and has a capacity of 6 tons per 24 hours. The ores of the Blue Wing district are amalgamating ores; therefore, it was necessary to haul galena from Argenta, at a large outlay, to be smelted with the Blue Wing ores. Two runs, one of which roduced 25 pounds, the other 47 pounds of silver, were made. The first ne was a loss to the owners; the second turned out a few hundred dolars profit. Since then the furnace has been lying idle, more for the ant of a head than from any other cause. But really these rich ores hould be worked by amalgamation, which is a much cheaper process, nd to which they are well adapted.

The principal veins developed in this district are the Black Hawk, reat West, Blue Wing, Arizona, Sibley, and others. The shafts are rom 75 to 125 feet deep and produce an abundance of silver-bearing res.

BIRCH CREEK DISTRICT.

This is an extensive district fifteen miles north of Argenta, containing rincipally copper veins. Almost all of them are rich in gold, and they re generally larger than the veins of the other districts.

The Treasure, *Greenwich*, and *Greenwich Extension* are the only develped veins. They vary from 6 to 12 feet in width. A shaft 80 feet eep has been sunk on the Greenwich. The vein has regular, smooth alls, and is 6 feet wide all the way down. The shaft on the Extension 130 feet deep. As soon as transportation gets cheaper, these mines ill be very valuable. So far no furnace has been erected, although the es are easily smelted.

The foot-hills east of Beaver Head Valley contain many veins of gold, ilver, and copper-bearing ores, some of which have been partly develped.

BIG HOLE.

This locality is situate thirty-five miles northwest of Bannack. The eins occurring here are all gold-bearing. One of them, the Sherman, particularly worthy of notice on account of its great extent. Its idth from wall to wall is 30 feet, and longitudinally it has been traced r a long distance. The quartz is soft and of a buff color; it is incased limestone and slate. Sufficient water-power and exhaustless quanties of timber are near by.

BALD MOUNTAIN.

The foot-hills lying south of and next to Bannack are filled with a perect network of gold-bearing veins, some of which are large and very egular. Shafts have been sunk on some of them to a depth of 40 feet. he matrix is quartz, which carries free gold.

BULLION PRODUCT.

The most reliable information which can be obtained places the value the gold and silver product of this county, for 1869, at $350,000 and at of 1868 at $300,000. It is estimated that since the first discovery the mines at Bannack the county has produced over $5,000,000 in recious metals.

COAL VEINS.

An extensive vein of bituminous coal was discovered in 1865 on the ig Hole, about sixty miles northeast of Bannack. The coal is of good ality and free from sulphur at the outcrop. Another equally as good in was found near Argenta, and a shaft 80 feet deep was sunk on it t year. This vein is associated with the fire-clay spoken of above.

Four miles above .Bannack two beds of lignite have been sunk with two shafts, respectively, 70 and 85 feet deep. Adjoining the excellent building stone is quarried. Other quarries of sandstone east of Argenta and at Beaver Head Cañon. The rock of the l locality answers admirably for grindstones.

SAW-MILLS.

Two saw-mills have been erected in the county. One of them is ted three miles above Argenta, convenient to the pine forests of Mountain; the other one six miles above Bannock and about five from the immense pine woods which cover the range of mountains t west of Bannack. Lumber costs $50 per thousand, in currency, at mills.

CHAPTER XLVIII.

GALLATIN COUNTY.

Gallatin County is situated south of Meagher, between the latter the southern boundary line of the Territory. Topographically it sists of two great basins—that of the Yellowstone in the east, and of the Gallatin in the west—separated from each other by the range, a spur of the Rocky Mountains. Both streams, in pas through the county, flow from south to north. The Yellowstone, arriving near the boundary line, makes an abrupt turn, and pursui nearly due easterly course, enters the Missouri; while the Gal meets the middle and west forks, called Madison and Jefferson Ri and united with them, commences the journey to the sea as the souri. A number of foot-hills and spurs subdivide both basins in system of valleys and cañons. The basin of the Yellowstone and headwaters of the Gallatin are but little known. The Yellowsto the favorite hunting ground of numerous roving tribes of Indians, no settlement is feasible. Notwithstanding the dangers threate from the ferocity of the red men, a number of miners have dare face the scalping-knife of the savages and have established a mi camp on Emigrant Gulch, a western tributary of the Yellowstone. gulch is seven miles long, and the gold produced from its placers i markable for its external characteristics. It consists of flat gr thickly covered with a layer of iron rust, and so defaced by the that usually its external features give no clue to its golden ke Considerable quantities of this character of gold reach the market nually, but no detailed statistics in reference to Emigrant Gulch a hand. In the entire Yellowstone Basin prospects of gold can b tained from many of its gulches and ravines, and there is a deep-se conviction among the miners that it contains rich placers. It is Eldorado of the dreams of many a hardy but impecunious prospect dreams whose realization may not be far distant. Parties who visited this *terra incognita* report it replete with grand and wond phenomena—crevasses of stupendous depth, petrified forests, plai lava and brimstone, geysers spouting boiling water fifty to seventy high, &c.; but their reports are too indefinite to serve for reliabl scription.

At present the entire civilization of Gallatin County is center the extreme northwestern corner, immediately south of the Three F f the Missouri, viz., in the Gallatin and Willow Creek Valleys. The rmer is situated between the east and west Gallatin Rivers, heading ı the south in the spurs of the Belt range, and runs nearly due north › within a few miles of Gallatin City, where the two boundary rivers me together and pass through a narrow cañon. To the east are pre- pitous mountains, and to the west low, receding foot-hills and a fine alley, extending to the Madison River. The valley is about forty iles in length and on an average about twenty miles wide. Middle reek, coursing through the center of the valley, furnishes abundant ater for irrigating the numerous farms on either side. This beautiful alley is not improperly termed the Egypt of Montana, as from it the ipply of grain, &c., during the immediate past has been chiefly ob- ained. The amount of small grain grown per acre is enormous. The rerage yield of wheat is forty bushels per acre, although as high as eventy have been obtained. Garden vegetables grow more luxurious ian in many of the eastern States. For grazing purposes the valley well adapted. The bunch-grass of the foot-hills sustains cattle and orses even during the winter without any other feeding. There are iree flouring mills in the valley; one at Gallatin City, one near Flat- ead Pass, and one at Bozeman, all propelled by water power.

Willow Creek district is a small section of excellent farming and razing country, about fifteen miles long and eight miles wide, between Villow Creek and Madison River.

The population of Gallatin County is estimated at 4,000, and the nount of taxable property, according to assessment rolls, is $579,802.

COAL DEPOSITS.

Coal crops out all along the Belt range, but has been opened only at ne point, some seven miles east of Bozeman, in what is called the pring Cañon. The coal is of good quality, and highly bituminous. he bed has been opened for about two hundred feet in length.

CHAPTER XLIX.

MINING LAWS, ETC.

The legislature of Montana passed, December 11, 1867, a law for the overnment of placer mines, the text of which is given in my last re- ort. It possesses, however, no practical bearings, as it is only appli- able to placer deposits discovered after its passage, and even in those ses permits the discoverers, under certain restrictions, to either con- rm to its provisions or adopt such others as they may prefer. In the rious codes in force actual possession by representation is the princi- le on which title is founded. In practice, however, nothing can be ore confused and uncertain than the mining rules in force in the vari- s gulches. The difficulties to be encountered in framing a general d equitable law capable of covering the peculiarities of every deposit, e distrust with which all legislative interference is regarded by the iners, and the desire they evince to be left to regulate their own affairs, ve prevented the passage of any act laying down uniform rules for e pre-emption and tenure of placer claims. The want of such a plain, certain, and equitable law has produced much vexatious litigation, and in some deplorable instances has resulted in bloody encounters. A still greater amount of trouble is only prevented by a strongly developed sense of justice among the miners.

TERRITORIAL QUARTZ LAW.

The pre-emption and tenure of vein deposits are regulated by the territorial law of December 26, 1864, which provides for eleven claims of two hundred feet each upon the discovery of a crevice with one well-defined wall. Its advantages, arising from its uniformity, are not to be undervalued. At the same time, however, it cannot be denied that its ill-advised provisions have done more towards retarding the development of the mineral resources of the Territory than mismanagement, extravagance, and swindling speculations put together. Copied from the mining codes of other communities, it has retained their special provisions without incorporating others to ameliorate their bad effect. Its most objectionable feature is the creation of constructive claims without any restrictions, objectionable because—

1. It places a premium on non-development.
2. It tends to the segregation of mining property in parcels too small for economical and profitable working.
3. It is the fruitful cause of litigation.

To fully understand the force of these objections it must be remembered that after the mere discovery of a lode it usually requires the expenditure of considerable money and labor to demonstrate whether it is a valuable and paying deposit or not.

Under the law there are nine distinct proprietors, all holding on the strength of one little gopher hole, each one of whom desires to avoid undertaking this necessary expense, hoping that his neighbor will do so for him. The consequence is that no work is done at all.

In my opinion the discoverer alone merits a reward for his industry, toil, and privations. He should receive sufficient ground, say 800 or 1,000 feet, so that, if his lode proves to be good, it can be worked in a proper manner. He would then know that he alone has to rely on his work to prove up his mine, and if he does not do so, he might as well have never made the discovery.

A tunnel law with extraordinarily liberal provisions is likewise in force.

UNITED STATES MINERAL LAW OF 1866.

When the passage of this law was first announced and before its provisions were fully understood and its effect realized, it was looked upon with the utmost distrust and its enactment was deeply regretted by the entire mining community. The law met with more favorable consideration when it was found that it did not infringe upon vested rights, but legalized possessory titles and merely gave an opportunity to obtain the United States title to those desirous of doing so, without being compulsory.

As soon as the Land Office was prepared to act under the law, a considerable number of applications for patents were filed, and a still greater number of mine owners determined to comply with the law and enjoy its benefits. Unfortunately experience soon demonstrated that the provisions of the law itself tended to render it inoperative. The following abstract of applications and entries admitted, communicated

. Lyman, the register of the United States land office, will best ate the practical working of the mineral act in Montana:

Month and year.	Number of applications.	Entries admitted.	Month and year.	Number of applications.	Entries admitted.
1867	1		November, 1868	1	
ar, 1867	4		December, 1868		
er, 1867	4		January, 1869		4
, 1868	4		February, 1869	2	
y, 1868	3		March, 1869		
868	4	3	April, 1869	1	
68	2	3	May, 1869		
8	None		June, 1869		2
68	3		July, 1869		
8	1	1	August, 1869	1	
1868	None				
er, 1868	2	1	Total	34	14
1868	1				

the entries admitted, three final patents were granted. From this t it will appear that during the last six months only two parties applied, and during the entire two years only thirty-four out of st fifty thousand parcels of mining property have sought the bene- the provisions of this law.

he operation of the law in the past has been unsatisfactory, there reason to believe that it will be much more effective in the future. uses which produce this result are much more easily defined than ies suggested.

Keyes, in my last year's report, explained at length that the law is s, excessively costly, and that even the issuance of a patent ot materially diminish the probability of litigation. Circumlocu- nd red tape have certainly done much towards discouraging many ould otherwise have secured the benefits of the law. Modes of ure should be simplified as much as possible, and this has been y done to some extent by a more liberal construction on the part Commissioner. Furthermore, there is no valid reason why the se of survey should not be borne by the government, as with agri- al lands. An objection more difficult to remedy is that the law not completely protect a patentee against vexatious litigation, partly to the nature of its provisions and partly to the loose ng of the law, leaving many questions open for discussion until re finally expounded by judicial decisions.

se objections have tended seriously to retard the effectual working mineral act, but they are secondary in importance to the conse- es springing from section 6.

correct understanding of the results which flow from its provis- must be remembered that a lode worth patenting is rarely without tants. Whenever a valuable ore-deposit is discovered the vicinity ediately covered with float locations. Every discoloration of the y rock, every moss-covered ledge, every stray boulder is staked as sis of a new discovery, either to secure some contiguous though distinct deposit, or more frequently to be used for purposes of ion and black-mail. In such cases, and they are very frequent, lication for patent is at once met by adverse claims. No other hen remain but to refer the matter to the courts.

y mine owners possessing claims that are yielding large returns gladly undergo all the delay, red tape, and circumlocution incident to an application, and cheerfully submit to the onerous expense which it entails, if by that means they could secure the United States title and immunity from litigation; but they are not willing, in attempting to do so, to become involved in law-suits, the expense of which may consume the value of the mine and the result of which may strip them even of their present possessory titles. Hence they decline the proffered patent and prefer to rest upon their present possessory claims, trusting that the progress of actual work in the course of exploration will defeat any adverse claims.

Two questions arise:

1. Is it desirable to render the law more effective ?
2. If desirable, how can it be done ?

To the first question the mining community returns an emphatic No! Miners are perfectly content with the enjoyment of their present titles and desire no change, apprehending that further litigation might infringe upon some of their present rights. I cannot fully agree with this sentiment. Believing the utter extinguishment of the United States title to be the true policy of the government, most conducive to the prosperity of the mining industry and the safety of the individual owner, I hold that we should endeavor to mold a legislation which cannot be avoided. I have already suggested remedies to some of the objections. The manner in which veins should be patented, whether in square locations or based on the plane of the vein with an interdiction of close parallel locations, is a question which might properly be left to a commission representing the various mining States and Territories. I believe, however, that the recommendations made in another part of this report will offer a basis of compromise on which all sections may agree.

ASSAY OFFICE.

Although the Territory of Montana has produced the precious metals largely for a period of over six years, and though the strongest proofs exist that not only her mining industry will be permanent, but also, that with ordinarily favorable seasons the yield will be increased from year to year, as it has been in the past, even under the difficulties presented by high labor, defective methods of working and communication—yet in spite of all these inducements, the government has not yet established an assay office in the Territory, though branch mints exist in some States and Territories of the United States the annual product of which in precious metals does not come near that of Montana. The Territory is far out of the way of the great connecting lines between the East and West, and distant from money centers; and being so entirely isolated, it enjoys none of the benefits of a regularly circulating currency. So far, gold dust has been used to a large degree as a medium to facilitate business transactions, but in the absence of a government institution, where values could be at once and definitely fixed, this has often been done at a great loss to the miner. And even in making shipments of their dust the miners have not fared any better, being compelled to submit to exorbitant charges for transportation. I am by no means in favor of establishing branch mints in different States and Territories, as that would entail unnecessary expenses on the government; all the coining can be done far better and cheaper in one mint only; but government assay offices, established with the two-fold view of facilitating the development of new mining districts by making their benefits accessible to all, and of turning the gold and silver immediately into the hands of the government, seem to me imperatively demanded in the new Territo-s as soon as the permanency of their mining industry is apparent. ch an office, by exchanging bars for drafts on the different sub-treasies, deducting the cost of transportation, which would be less for the nited States than anybody else, because large shipments may be made a time, is of the greatest importance for the Territory of Montana. t present Helena seems to be the proper place for the office, on account its central location as well as for the reason that it is the main busiss place in the Territory.

GOLD PRODUCTION OF THE TERRITORY.

To arrive at a correct approximation of the gold product is extremely ficult. On the one hand, gold dust is still, to a considerable extent, e currency of the country, and the amount used for that purpose is ctuating and difficult to ascertain; on the other hand, the operations assayers, bankers, and express companies are not yet made public. sed upon the best information obtainable, I would place the gold proction of Montana for the year ending July 1, 1869, at $12,000,000. e estimate for 1869, given at $12,000,000, in the letter introductory this report, was based on the yield of the fiscal year. Later reports, eived while preparing this volume for the press, indicate a much aller production, owing to the drouth. One correspondent puts it as r as $9,000,000; but I believe this would be too great a reduction. The coming year will undoubtedly benefit by the decrease during the sent, and the gold product of 1870, with a moderate supply of water, y be expected to exceed $15,000,000; with an adequate amount it is ly to reach $20,000,000.

SECTION VI.—UTAH AND ARIZONA.

CHAPTER L.

GENERAL REMARKS.

he mineral resources of Utah Territory are imperfectly known, and the completion of the Union Pacific railroad has not stimulated pecting and mining to a very large degree. This is undoubtedly ly due to the known hostility of the Mormons to mining. Still some ortant discoveries have been made and a few companies have com- ced developing several districts.

he coal and iron deposits in the northern part of Utah will probably ive more attention in the immediate future than most other mineral urces of the Territory. These beds are of the highest value for the on Pacific railroad, and it is said that the company contemplate ting rolling mills at Echo City, a point which is admirably suited this business on account of the nearness of extensive coal and iron osits. Very good bituminous coal is found on the Bear and on ber Rivers. The beds on the Weber lie mostly above the water level are from 5 to 12 feet thick. The vein exposed at Evanstown on the r River is 17 feet thick and considered the best coal for many pur- es in the entire West. These veins, being situated near the railroad, undoubtedly be drawn upon largely, not alone for the supply of the l itself, but also for use in the States west of that point.

t the head of the Timpanagos, just below Kansas Prairie, above il's Gate, on the Weber and in the Wasatch bordering the valley, ar deposits of magnetite; and higher up on the Weber, ten or twelve es above the confluence of the Echo with Weber, are found hematite , fire-clay, and coal. The latter, however, is not very good. Exten- coal and iron deposits are also found in the southern part of Utah. y are of little account at present, but will be extremely valuable for Utah railroad as soon as it is pushed through to the Colorado.

ear the headwaters of Silver Creek, an affluent of the Weber, large ies of carbonate and black oxide of copper have been found. These carry a small percentage of silver. Alum shales in vast beds exist he Promontory range.

he Bingham Cañon and the Rush Valley mines both belong to the e mineral-bearing belt which in the east makes its first appearance r the point where the Uintah Mountains and the Wasatch meet. former range has a nearly east and west course, and the latter trends th and south, so that both form a T, the standard of which are the tah Mountains. At the point spoken of the mineral belt occupies both ks of the Uintah range. From here the belt extends west, cross- the Wasatch and continuing down its western slope along Little and Cottonwood Cañon. Crossing the Jordan Valley, a beautiful agricul- al district, it makes its appearance again in the Oquirrh Mountains, an ated range running north and south and separating Jordan from h Valley. The distance across the mountains is about twenty miles.

On the eastern slope lie the Bingham Cañon, on the western the Rush Valley mines.

In the Cottonwood Cañon district from fifty to one hundred mineral-bearing veins have been located. Very few of them have, however, been opened so far. The most work has been done on the Lone Star, Magnet, Illinois, Ida, and Monitor. The shaft on the Ida is 100 feet deep, and shows a vein two feet wide in the bottom. The lodes are mostly from one to four feet in width, and carry principally argentiferous galena with considerable antimony and zinc. Assays have yielded as high as from $160 to $400 per ton in silver, but the average value is estimated to be $50. Woodhull & Co. have shipped 15 tons of their ore to San Francisco, to ascertain its value and the best way of treatment. Timber and firewood are rather scarce in the district, though there is enough for the present. The locality is from 9,000 to 11,000 feet above the sea, and a great deal of snow falls in the winter. The supply of water in the summer is ample.

The veins in Bingham Cañon carry gold, silver, and copper; the latter predominating largely. In West Mountain district, situate in Bingham Cañon, lead ores occur besides the above. A Chicago company are said to have invested largely of late in consequence of the very favorable report made by Professor E. D. Moorehouse on the lodes of the district. Smith & Co. have lately sent 12 tons of their cupriferous ores to Baltimore for a test. They expect them to yield forty per cent. of copper and $60 per ton in silver. Sixty tons more are ready for shipment to San Francisco. Some placer mining has been done in this district; but, owing to the scarcity of water, it could not be successfully followed except in the early part of the season, when the melting snow furnished plenty of water. The bed rock lies very deep; in most places, 75 feet below the surface. A bed-rock flume, 400 feet in length, has been constructed, but it did not reach bed rock, and the parties will have to start further down the valley and go over the same ground again. The placers yield about $5 per day to the head.

The Rush Valley mines were discovered by General Connor in 1865, and considerable excitement about them prevailed at the time. Companies were organized in the East, and smelting works were erected before the mines had been properly opened. The ores are principally silver-bearing galena and copper ore, with a heavy admixture of gangue. The furnaces erected were not a success; technical as well as economical reasons prevented it at the time. Lately Captain James M. Day, formerly connected with the Savage mine on the Comstock lode, has leased these mines, and is erecting a furnace, the fire-proof material for which he has to procure from the neighborhood of Salt Lake City. I have no late news in relation to this enterprise.

The Sevier mines in Juab County have attracted considerable attention, and raised quite an excitement during the latter part of 1868 and the summer of 1869. They are situated a few miles from the Sevier River, and about one hundred and eighty miles due south from Salt Lake City. The placer diggings have been known to exist for several years, and were worked in a small way by Mormons. Only lately, however, were ledges of auriferous quartz discovered a short distance away from the river in the mountains. Most of them cluster around Mount Nebo, which reaches an altitude of 12,000 feet. The country here abounds in wood and water, and the streams have all considerable fall except the Sevier itself, which becomes rather sluggish after reaching the plains.

The lodes are all mostly large and easily traceable for long distances. The principal locations taken up are the Gould and Curry; vein 35 feet wide on top; the Webster outcrop, 60 feet wide; the Bully Boy, an extension of the foregoing; the Illinois, averaging 7 feet in width, and sunk upon to 100 feet in depth; the Niagara, a very large ledge; the Great Western, Young America, Yankee Blade, and Schimmerhorn. Some fifty more have been located, but they are mostly entirely undeveloped.

The discoveries in Clifton mining district at Deep Creek, immediately north of the Western Union telegraph line, are highly spoken of, but too little is known about their value to give them more than a passing notice. The mineral belt in which the veins occur is described as four miles wide and ten miles long. The country rock is granite, and in it occur ledges of argentiferous galena, samples of which are said to have yielded by assay from $75 to $100 per ton. The district is said to be abundantly supplied with wood and water.

Forty miles west of Promontory City new placers were discovered during last year. They are situated on the south side of Raft River range, and only ten miles from the line of the railroad. Indian Creek, Dove Creek, and Sagebrush Creek, all running southerly, are the principal gulches. All these streams are lost in the desert before reaching Salt Lake. They furnish enough water to supply the diggings during four or five months only, but, as the mines are said to be rich, water will probably be brought to them from other sources.

On the whole it may be said that, so far, Utah cannot be classed among the mining States and Territories. The developments made are all very slight and unimportant, and no shipments of any consequence of the precious metals have ever been made. The Union Pacific railroad, however, will undoubtedly do much in the future toward the development of the mineral interest in the Territory.

ARIZONA.

Comparatively little progress has been made in mining in this Territory, owing to the presence of hostile Indians and the consequent danger and high prices.

The Vulture gold mine, near Wickenburg, in Central Arizona, has been steadily worked since 1866, and gives an average yield of about $300,000 per annum. Forty stamps are in use, and it is now proposed to force water to the mine from the Hassayampa River, a distance of fourteen miles, and remove the mill from that river to the mine, which, if done, will save the large amount now paid for the transportation of the ore. A traction engine has been ordered from England to be used in transportation. The Big Bug mines, near Prescott, Central Arizona, are now worked and making a successful return. A 10-stamp mill is in use.

The Sterling mine, also near Prescott, has a 10-stamp mill and is reported to be yielding well.

Many men are engaged throughout Central Arizona in sinking shafts and running tunnels upon lodes preparatory to the erection of mills.

Upon the great Colorado River some work has been done at the Eldorado Cañon silver mines, and ores are constantly sent to San Francisco from the argentiferous galena deposits at Castle Dome and Eureka. In copper there has been but little done during the past year.

In Southern Arizona a fine 10-stamp mill has been erected at Apache Pass, on the southern overland mail route, and the gold lodes promise well. Work has been in a great measure suspended, owing to the mur-

der by the Apaches, in October, 1869, of Colonel John F. Stone,
superintendent.

Some English capitalists have lately sent engineers and mining exp
to examine the Santa Rita lodes, and those at the Cerro Colorado,
a view to purchase. Throughout the Territory, at various points, pl
mining is carried on to a limited extent, and considerable gold qu
is annually crushed by arrastras.

It is estimated by those well informed and worthy of confidence
the Territory has yielded an average of $1,000,000 per year in th
precious metals for the last ten years, and that with proper protec
for life and property, and the construction of the Southern Pacific
road, it would soon yield as large a return from its mineral resource
any Territory in the Union, while it has much more agricultural l
than is commonly supposed, and its pastoral lands are unsurpassed.

In an address made at Prescott, November 5, 1869, Governor Saff
the new governor of the Territory, who has had much experienc
mining in California and Nevada, said:

> Now I come to the mineral resources of the country, and I feel that I can spe
> this branch with more confidence than any other, because I have spent all my man
> in the mines—for eight years in succession I worked at placer mining, lived in a c
> and cooked my own meals; and for nearly twenty years have been connected
> mining enterprises of one kind or another. I have taken part in gold and silver qu
> mining in California and Nevada, and have examined the principal mines and re
> tion works of Europe. My previous knowledge of mining has naturally led m
> take special interest in examining the mineral resources of this country. I have
> eled in various directions from the southern boundary of Arizona north to this p
> I have found the mountains threaded with veins rich in silver, gold, and coppe
> beyond anything I have ever seen elsewhere, and I here predict that the time will
> in the not very far off future when Arizona will produce more gold and silver tha
> the balance of the Pacific coast. This may be considered enthusiastic, but when
> considered that there is hardly a mountain over this vast Territory that does not
> tain rich lodes of gold and silver, while for hundreds of miles the ravines show
> pects for placer diggings that would gladden the heart of any old California miner
> when it is considered also that the wealth of these mines is yet untouched, the
> diction will not appear so extravagant. The inquiry will be made, if Arizona con
> such vast mineral wealth, why has it not been proven before this time? Ther
> several reasons, either one of which is sufficient to result in the failure of any ordi
> paying mine. First, the hostility of the Indians, which has almost wholly preve
> prospecting for mines, and rendered their working insecure and expensive. Sec
> the expensive transportation of everything consumed or used that is not raised
> Third, the want of capital to open the mines. Fourth, the want of experience
> knowledge how to extract the precious metals from the ore. To ascertain the me
> of extracting gold and silver from ores, and particularly those that are refractory,
> in all new mining districts required money, time, and experience, but in no case
> either of these metals been found in paying quantities, that a process has not
> found to save them, nor will this country be an exception. The ores are found he
> vast quantities, fabulously rich. In experiments that have been made here, thr
> the extravagance or inexperience of those who have made them, the money has, in
> instances, been uselessly squandered. Large mills have been erected before ope
> the mine, or attempting to ascertain a method of saving the metal. The consequ
> has been that the mill, when erected, could not be supplied with ore, or the pa
> managing it could not save the gold and silver; and the stockholder, who never
> the country, and knew nothing of the cause of failure, became disheartened, and
> mine is abandoned and left to decay. If mining could be conducted with the
> economy that the merchant conducts his business, or the farmer tills his fields, fai
> would seldom occur. But our eastern friends who have sent some capital for in
> ment here seem to break loose from all the well-established principles of doing busi
> and adopt a new system for mining. Instead of selecting a man to open their m
> and erect their machinery who is experienced in the business, and has establish
> character for integrity, they either send some one they want to find a place for, wh
> incompetent to be placed in charge of business there, or the relative of some infl
> tial stockholder, or, perhaps, in some instances, very good business men, but invari
> none of them know anything about mining, or machinery for the reduction of ores,
> their education proves very expensive for the owner, and results in incalculable in
> to the country. Laboring under all these disadvantages, still we have to-day in
> cessful operation one of the best paying mines on the Pacific coast—the Vultur

> ckenburg. The Apache Pass mine, at Apache Pass, is just starting, with equally
> orable prospects of success. The mill at Big Bug will in a few days be in successful
> ration, with an inexhaustible supply of ore before it, and practical tests have dem-
> trated that Mr. Heslep, who is in charge, has overcome all obstacles, and that it
> l soon be numbered among the best paying mines on the coast. The same may be
> l of the Sterling. I visited it a few days since, and was impressed with the excel-
> se of the machinery, and also with the regularity of the lode, and the large quanti-
> of ore it contains. I say to you, not for the purpose of creating a false hope, to be
> good cheer. As sure as the sun rises and sets, the day of your prosperity is dawning.
> sona has seen the worst; her immense wealth cannot lie dormant much longer.
> * * I would advise all who are not able to work their mines, and who have a
> icient amount of work done, to secure a government title as soon as possible. You
> sure of your property, then, wherever you go, and if you desire to sell, you have a
> that gives confidence, more than a mere possessory right. When I arrive in San
> ncisco, I will endeavor to have the surveyor general of California appoint a mineral
> aty here, and as soon as that is done you can apply for a patent at once. The law
> rides that when the public surveys have not been extended to any mining district,
> a the surveyor may establish some initial point, and connect all the surveys to it,
> after the public surveys have been extended, then this initial point will be con-
> ted with them.

hope that a Territory so promising may be afforded at least as much
istance as has been rendered in various ways to all the other mining
ions.

SECTION VII.—WYOMING TERRITORY.

CHAPTER LI.

THE SWEETWATER DISTRICT.

Although the mines of this district attracted considerable attention as early as 1868, it was impossible to collect out of the mass of contradicting reports anything like reliable information before the completion of the Union Pacific railroad was an established fact. Since that event, however, took place, safer and more direct communication with a region so near to the national highway between the East and West has enabled me to communicate the following detailed description of the mineral resources of this important section of the new Territory of Wyoming, as far as they are known at present.

SITUATION AND APPROACH.

The Sweetwater mines are situate in Carter County, Wyoming Territory, in about latitude 42½° north, and longitude 109° west of Greenwich, some fifty miles in a direct line north of Point of Rocks Station, on Bitter Creek, Union Pacific railroad, and about twelve miles north of the South Pass on the old California overland route. They are reached via the town of Bryan, Union Pacific railroad, Green River Ferry, Big Sandy Creek, Little Sandy Creek, the Pacific Springs, and South Pass City, one of the principal mining towns of the district. The distance between Bryan and South Pass City is one hundred miles. Mr. Benham has established a daily line of coaches between these two points, who carry passengers through in twelve hours for twenty dollars. This line carries also Wells, Fargo & Co.'s Express. Another more direct route leaves Point of Rocks Station in a northern direction and reaches South Pass City by way of Black Rocks and Sweetwater Station, on the overland road. The distance amounts to about seventy miles. Mr. Laramie runs a daily line of coaches on this route and carries passengers for ten dollars.

The distance from Sacramento, California, to Bryan is 914 miles; from Omaha to Bryan, 860; and from Point of Rocks to Bryan, 53 miles. Freight is carried from Bryan to South Pass City, at the rate of from one and three-quarters to two cents per pound, and from Chicago at from four and a half to six cents.

The three principal mining towns are South Pass City, Atlantic City, and Hamilton. The two latter are situate respectively four and eight miles northeast from the former, and in communication with it by coaches running twice a day.

From the above it appears that the district is of easy access from the eastern as well as the western States. The completion of the Union Pacific railroad has done wonders in this once so remote part of the country. It has caused the organization of the new Territory of Wyoming; it has opened the extensive coal-fields at Carbon, Black Buttes, Point of Rocks, Bitter Creek, Evanston, and elsewhere, and given a new impetus to the development of the vast and really valuable mineral resources of the Sweetwater district, which before were almost out of reach on account of the remoteness of the locality and the danger from Indians. It is much to be regretted, however, that the line of railroad does not follow the California overland road through South Pass. The heavy grade and the severe winter snows of the Black Hills, as well as the terrible Bitter Creek desert, might have been avoided by such a course.

All the old hunters and mountaineers, who have had long experience in this region, agree that a grand mistake was made in locating the railroad where it now is. They assert that a far better route and a very gradual and easy ascent of the mountains could have been gained by passing up the North Platte to the mouth of Sweetwater, up this stream to South Pass proper, thence to the Big Sandy and down to Green River; that, following this route, the road would have passed through a country rich in mineral and agricultural resources; that it could have been built at much less expense, and that no snows would have impeded transportation in the winter.

GENERAL OROGRAPHICAL AND HYDROGRAPHICAL FEATURES.

About thirty miles northwest of South Pass City, the main range of the Rocky Mountains, here called Sweetwater and Wind River Mountains, rises with its snow-covered peaks high above the surrounding prairies and highlands. It is seen at a great distance and breaks the monotony of the scenery very agreeably. Its general characteristics vary in no way from those of the Rocky Mountains in Colorado and New Mexico. In a southeastern direction, however, toward South Pass and the Black Hills, this high range breaks off rather suddenly, and mountainous highlands with low, undulating hills form its continuation. The hills rise generally not more than five hundred feet above the streams and gulches, which, intersecting the country in all directions, descend very gradually. Some of the creeks flow north into Beaver Creek, a tributary to the Wind River, which by the Big Horn and Yellowstone sends its waters to the Missouri; others running easterly into the Sweetwater are tributaries of the North Platte; still others, flowing in a southwestern direction into Green River and thence into the Colorado, reach the Pacific Ocean.

To illustrate the hydrographical features of this region by a very striking case, I might mention the occurrence of two springs near South Pass, about twelve miles south of South Pass City; they are close together, but one of them sends its waters to the Pacific, the other to the Atlantic Ocean.

Spring Gulch, on which the town of Hamilton is situated, empties like Yankee and Meadow Gulches into Beaver Creek. Strawberry Creek, Rock Creek, and Willow Creek flow into the Sweetwater. On the two latter Atlantic City and South Pass City are located. Cariso Gulch and Big and Little Hermit Gulches empty into Willow Gulch.

The Sweetwater River.—This stream heads in a beautiful little lake on the western slope of the Sweetwater Mountains, about forty miles northwest of South Pass City. It runs about one hundred and fifty miles in an easterly direction and finally empties into the North Platte. The headwaters of Big and Little Sandy Creeks, which flow into the Green River, are close to those of the Sweetwater.

All along the course of the latter stream are large tracts of land well adapted to agriculture, and gold is found from the little lake to the 'latte River in the sand and gravel of the banks and the stream. The ecayed remnants of sluice-boxes, which are found on the upper Sweet'ater, suggest that long before the late rush to these regions, miners ave worked here for gold. I shall revert to this point hereafter in the istorical account of this district.

The Green River has its source in Lake Matheson—so called in honor f its discoverer. This beautiful sheet of water is situate about one undred and twenty-five miles northwest of South Pass City, on the 'estern slope of the Rocky Mountains. The Green River traverses, n its way southward, fertile valleys and prairies containing an immense xtent of arable land. Extensive gold-bearing gravel deposits were iscovered a few years ago by a party of hunters, and the facilities r hydraulic mining are such that it is confidently believed these eposits can be worked very profitably. The country about the head f Little Sandy, one of the tributaries of Green River, is thickly timered. Lumber will square here as much as 30 inches. Galena has een found near the same stream.

The Wind River.—The source of this river is on the eastern slope of he Wind River Mountains; the valley of the same name lies about hirty miles northeast of the principal mining districts on the Sweetwater. t is conceded by competent judges to be one of the largest and most eautiful valleys between the Missouri and the Pacific Ocean. Its verage width is about eight miles; its length is variously estimated at rom one hundred and fifty to two hundred miles. Wind River empties nto the Big Horn, which is a tributary to the Yellowstone and Missouri. he banks of the river and those of the numerous smaller streams feeding t are thickly covered with a growth of large cottonwood trees; the mounain sides adjacent to the valleys abound in the finest pine and fir forsts. The soil of the valley is a dark loam, capable of producing all the rops raised on a Missouri River bottom farm. The climate in winter s very mild; snow never falls to a depth exceeding six or eight inches. his, as well as the abundance of game found in the valley, has induced any of our old hunters and several Indian tribes to winter here year fter year. No finer grazing country can be found in the United States. bout fifty ranges are taken up by white men for agricultural purposes, nd the fruits of their industry will find ready sale at the mining camps r years.

Coal and petroleum are said to have been found in several parts of he valley; in its upper end a very strong spring of hot sulphur water as been discovered.

HISTORY OF THE SWEETWATER MINES.

The earlier history of these mines is comparatively unknown. An teresting account is given in an article in the "Sweetwater Mines" of arch 24, 1869, a short abstract of which may be appropriate here, as lustrating the many hardships and disappointments to which our early estern pioneers have been so often subjected.

Gold in the Sweetwater district was first discovered in 1842 by a eorgian, who came here with the American Fur Company for the covery of his health. After remaining a year he started for home, tending to organize a company and bring them here to work the ines. He never reached his home, however, and was supposed to have en killed by Indians. Thirteen years elapsed, when a party of forty en arrived here. They prospected the whole length of the Sweetwater, und gold everywhere in the river as well as in all its tributaries, and rned the main stream from its channel for 400 yards. A small shaft, eight feet deep, from which they took from two to ten cents worth of gold per pan, was sunk and worked for some time. Winter approaching, they abandoned their enterprise to winter at Fort Laramie, where they intended to provision themselves for a year and get a supply of necessary tools in the spring. This done they started, but when on their way two days they were overtaken by United States dragoons, and brought back to the fort; the leader was sent to prison for some imaginary offense, and the property of the company was confiscated. In 1858 the leader returned to this region, but did no mining until the summer of 1860, when he and eight others commenced mining on Strawberry Creek. Their rotten sluices, rockers, and toms remain there to the present day. During 1861 mining was abandoned, because men could make more money putting up hay, delivering telegraph poles, &c., for the Overland Stage Company. In the fall of 1861, however, fifty-two men had collected at South Pass City ready to commence mining in the early spring of 1862. Their locations were selected, and prospects were promising, when, like a thunderbolt, the Shoshone Indians broke down on them, robbed them of everything and drove them off. This put a stop to mining operations until the fall of 1866, when a party, led by the same man who guided all the former expeditions, came down from Virginia City, Montana. They wintered on the Sweetwater, and June 8, 1867, the Cariso lode was discovered by H. S. Reedall. A mining district was organized and called Shoshone district. Mining laws were agreed upon and regulations entered into by the pioneers.

Reedall and his party commenced working the Cariso lode, when they were attacked by Indians, who killed three of them and drove off the remainder. The survivors returned to the mines July 28, and remained over winter. They succeeded in extracting from the croppings of the lode, which they crushed in a hand-mortar, $1,600 in gold. Seven thousand dollars more they washed out of the detritus in the gulch below the vein. The news of this success spread rapidly and was greatly exaggerated. A great rush commenced from the neighboring Territories, but the majority of the adventurers, not finding the facts to bear out the reports, left very soon. Only about five hundred remained and went to work. Their labor was well rewarded, and gradually more population was attracted, so that in July, 1869, 2,000 people had settled here. They were doing well and apparently satisfied with the results already reached, and their future prospects. Although all those persons came to the district poor they had three mills with twenty-six stamps running, and several arrastras were in operation.

Among the fifteen hundred lodes discovered a great number are necessarily worthless; but many have proved to be sufficiently rich for profitable working, and capital is beginning to be invested. Twelve mills, with one hundred and sixty-one stamps, will soon be running, and on the whole the future of the district looks bright and cheerful. The gold occurs principally free in veins of quartz. Many of these have been opened and worked by shafts and surface pits, but the extent of country prospected and explored so far is so small that a much greater number may be confidently expected to exist. The placer-workings, too, are as yet of a comparatively limited extent, and the area of untouched ground which might be profitably worked by hydraulics is very large.

GEOLOGICAL SKETCH.

The geological formation of the country around South Pass City, Atlantic City, and Hamilton is very uniform. The country rock con-ining the mineral belt near these towns consists exclusively of meta-rphous and azoic rocks. Hornblende rock and slates are predomin-t. The strata are folded and tilted to a considerable extent, and vary nsiderably in strike and dip. The rock, being very hard, has resisted e decomposing influence of the atmosphere, and is in many places en-ely bare and uncovered by detritus. Striæ on the tops and slopes of ls give evidence of former glacial action in some instances. Pros-cting and the discovery of lodes could not meet many difficulties in a ntry like this, especially as many of the veins carry huge croppings quartz, which are traceable for miles. Where the lodes do not crop t above the surface the "float" is usually found near by. Following p the ravines and gulches, the prospector can easily find the mother in.

Southwest of Atlantic City the country rock is predominantly of a ty character. Here occurs a body of syenite. Limestone is found ar Hamilton, and also on Slate Creek, an affluent of Rock Creek.

THE LODES.

he main belt of lodes between Atlantic City and Hamilton follows a neral northeast and southwest course; but within this limit there is nsiderable variation in the strike and dip of veins. Some of them run rallel with the stratification of the country rock, others traverse it at small angle. Mr. Wm. Buckner's field-book furnishes the following arings of a number of lodes. It must be remembered, however, that ne of these claims were quite insufficiently opened to permit of de-mining finally the true strike, and later workings may disclose some-at different facts.

Table of bearings.

Lodes in Shoshone district, situate south of Rock Creek:	
Young America	N. 86° E.
Cariso	N. 60° E.
Washington	N. 68° E.
Austin City	N. 72½° E.
King Solomon	N. 52° E.
Golden Gate	N. 70° E.
Garden City	N. 47½° E.
Nellie Morgan	N. 58½° E.
Barnaba	N. 57° E.
Plutus	N. 77½° F.
Mary Ellen, (Perkins's)	N. 32½° E.
Calhoun	N. 87½° E.
Gold-hunter	N. 87½° N.
Swiss	N. 66½° E.
Lodes in California district, situate north of Rock Creek:	
Soles and Perkins	E.
Buckeye State	N. 40° E.
Julian	N. E.
Chinook	N. E.
Montana	N. 62½° E.
Cariboo	N. 87½° E.
Mammoth	N. 77° E.
Atlantic	N. 73° E.
Lodes near Hamilton:	
Miners' Delight	N. 40° E.
Bennet Line	N. 3° E.

he dip of the lodes varies from 50 to 90 degrees, and is mostly ards the northwest; some of them, however, dip to the southeast.

Their width varies from one to twenty-five feet. At least, one of the walls is generally smooth and well defined, especially when the strike and dip of the vein corresponds with that of the country rock. The walls of cross-veins are mostly imperfectly defined.

The ore of the district is mainly quartz, in which oxide and silicate of iron are finely divided. The dark shade thus imparted to it has caused the miners to commonly call it "black iron." Some of the quartz, however, is white and transparent, like that of California, and shows specks and threads of free gold in a few instances. Most of this class shows no gold at all, but after pounding the ore in a mortar and washing it, the metal becomes visible. The dark kind of quartz is the most common; yellow and red stained varieties are frequently so much decomposed that they can be easily crushed between the thumb and forefinger. The miners call this kind "sandy quartz," and consider it richer in gold than the harder ore.

The gold is not very fine; flour gold is rarely met with. It is of good quality, being on an average about .850 fine in gold, and .150 in silver. Being very free, *i. e.*, in a bright metallic state, without any coating whatever, the gold is very easily extracted from its matrix by the ordinary mill process. The amalgam, after having been strained, yields fifty per cent. of gold bullion by retorting.

From the above it is evident that the character of the Sweetwater ores presents extraordinary facilities for the cheapest and simplest methods of reduction. They are therefore in great favor with American miners and millmen, who do not like to have anything to do with refractory ores. Base metals, such as lead, zinc, antimony, tellurium, copper, &c., are very rare, and to all appearances the percentage of iron pyrites will be very small, even at greater depth. In a few lodes only malachite and copper pyrites are found interspersed in the quartz.

The average yield of several thousand tons of ore from different lodes has been from $30 to $40 per ton. The richest ore, yielding $100 and over to the ton, is taken from small lodes with an ore streak of one to two feet wide; lodes of from four to five feet wide contain a medium quality of ore, and the large veins of a thickness of 10 to 25 feet contain a vast amount of low-grade ores. The latter will undoubtedly constitute the main strength and most reliable basis for the mining enterprises of the future.

Most of the gold bullion produced during the last year has been extracted from the ore of the Cariso and Miners' Delight; on these two lodes the largest amount of work has been done.

The Cariso lode.—This is situated about half a mile northeast of South Pass City on Cariso Gulch, and is the vein first discovered and located in the district. The principal workings are located on the east side of Cariso Gulch. According to the records of the district 1,600 feet have been located on it east of the discovery stake, and 1,400 feet west of it. All the different claims of 200 feet each are worked segregated, and some of them have changed proprietors several times.

On Van Orden's claim, No. 1, west of discovery stake, a tunnel following the course of the lode and commencing near the gulch is run about 70 feet into the hill. At the eastern end of the claim a shaft has been sunk, and out of an open cut between the mouth of the tunnel and the shaft, some surface ore has been taken. Reedall's, the discoverer's, claims are next to the east. The discovery shaft is 15 feet deep, and open cuts are on both sides of it. Out of these openings about $7,000 worth of gold have been taken. The eastern end of the discovery claim was bought by Bolivar Roberts, who sunk an incline

5 feet deep on the lode. It dips seventy-five degrees southeast. A pur joins the main lode at a depth of 30 feet. At a depth of 35 feet nd 47 feet, respectively, drifts have been run east and west, from the haft. The average width of the ore streak is three feet between well-efined walls of hornblende slate. About 50 feet from the eastern end f the Roberts property, on Reedall's claim, No. 1 east, a shaft has been unk to a depth of 35 feet; 125 feet further on another shaft 35 feet eep has been sunk, and about 500 tons of ore have been taken out of he latter and a drift running from it westward. On Terry's claim is a haft 40 feet deep. This was the most eastern claim explored on the ode at the time of visiting the locality.

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Hermit mill.—This mill was built by the Union foundery, San Fran-isco, California, and was the first one erected in the Sweetwater dis-rict. It has six stamps, and the motive power is supplied by an over-hot water-wheel of 20 feet diameter and 4 feet breast. The stamps eigh 650 pounds each, and fall 8½ inches at the rate of 80 drops per inute. They reduce 12 tons of quartz to great fineness in 24 hours. malgamated copper plates are used in the battery-box. One and one-uarter ounces of quicksilver for every ounce of gold contained in the re are put into the battery from time to time. The pulp passes through No. 70 wire screen, over amalgamated copper plates. In the battery elf little water is used, but through a perforated pipe, passing across he upper part of the plates, more water is added to keep the latter lean, and thus facilitate amalgamation upon their surface. Their incli-ation is ten degrees, and the amalgam is scraped off twice a day. fter passing them the pulp runs over 50 feet of blankets and thence hrough 50 feet of riffled sluices. The blankets are washed every twenty inutes, and the washings, amounting to about 2,000 pounds per day, are reated in charges of 1,500 pounds, in a Wheeler pan. Two and one-alf pounds of quicksilver are added to a charge. Of the whole mount of amalgam, ninety-five per cent. are collected from the battery-ox and plates, and only five per cent. result from the amalgamation of he blanket washings. Of the ninety-five per cent. about seven-eighths re taken from the battery, and one-eighth from the copper plates. Three pounds of gold amalgam yield by retorting nearly two pounds of old. The gold from the Cariso lode is not very fine. Ore from the oles & Perkins, which was under treatment at the time of visiting he mill, contains coarser gold. Four men, two to each shift, are con-inually employed by the mill—two as feeders and two as blanket wash-rs. The latter have to attend to the pan amalgamation in addition to heir other duties. The feeders of the battery have to be experienced en, and receive $90, currency, and board, per month. The blanket ashers are paid $60, currency, and board.

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The Young America, on the west side of Cariso Gulch, is owned by an

Ohio company; A. G. Sneath, superintendent. Their discovery shaft has reached a depth of 52 feet, and about 15 tons of fine-looking ore, expected to yield $60 per ton in gold, are lying in the shaft-house. About 125 feet from the first a second shaft has been sunk by the company, which has reached a depth of 48 feet. Its dimensions are five by nine feet. The lode is perpendicular, and at the bottom of the shaft two and one-half feet wide. The ore taken from this shaft, said to be worth $40 to $45 per ton, is white and dark blue quartz, with free gold. The company is erecting a 10-stamp mill, with frame for five additional stamps, in Big Hermit Gulch. It is to be driven by a 20 horse-power engine.

The Austin City.—The discovery shaft has reached a depth of 50 feet. The lode is three feet wide, perpendicular, and corresponds in strike and dip with the incasing slates.

The King Solomon lode near the gulch of the same name is remarkable on account of its huge croppings. King Solomon Gulch is a dry gulch and prospects very rich. The shaft sunk on the lode is 40 feet deep and exposes to view a quartz ledge eight to ten feet wide.

The Golden Gate is about one mile northeast of the Cariso lode, and nearly in line with it. It was discovered October 12, 1868, and is now owned by Morris, Molitor & Co. A shaft 50 feet deep shows the lode dipping 75° northwest, and seven feet wide. From 300 to 400 tons of ore are lying on the dump awaiting reduction.

The Garden City, owned by the same parties as the foregoing claim, lies north of it. A cap of 12 feet was passed through in a shaft 26 feet deep. The lode being two to three feet wide, has a good hanging wall, and dips 70° south. About 20 tons of ore, 14 of which have yielded $16 75 per ton, have been taken out.

The Nellie Morgan lode, owned by Snyder, Theall, and others, is situate about half a mile east of South Pass City, on a hill east of Hermit Gulch; on the top of this hill the discovery shaft was located. The vein runs parallel with the stratifications of the country rock, and dips 80° northwest. It is seven feet wide at the surface, and shows at the bottom of the shaft an ore streak of 22 inches in width. The quartz is partly soft and decomposed, of dark blue and greenish color, and resembles the ore from the Sales and Perkins and the Cariso. The owners pay $15 per foot for sinking the shaft.

All these lodes are situated in the immediate neighborhood of South Pass City. The hills presenting no steep grade, so that a wagon can be driven over them without any difficulty, they are easily accessible.

About six miles west of the town the Scratch lode was discovered, and recorded April 3, 1868. Its ores contain malachite and yellow sulphuret of copper. Some of the lodes on Slate Creek, and a few of those between South Pass City and Atlantic City, show also traces of copper pyrites near the surface.

In other mining districts, as, for instance, in the gold districts of Central City, Colorado, experience has shown that gold ores containing copper are generally very rich; such ores, however, give up their gold very imperfectly by the ordinary stamp mill process, and have to undergo several smelting operations, thus enhancing the cost of production considerably. No analyses being on record, it remains for the future to reveal a possible analogy of these ores to those from Colorado. On the south side of Rock Creek, between the two roads leading from Atlantic to South Pass City and the mill, two quartz lodes, parallel to each other and traversing the stratification of the tilted slates at an angle of about 45°, have been located. They have been named the Goldhunter and the Calhoun.

Goldhunter.—The discovery shaft is 50 feet deep and an incline.) of the lode is 75° northwest. About eight tons of ore have iken out, none of which has been tested by mill process. The iim on this lode, 1,300 feet long, is owned by Pease & Co., the laim of 1,200 feet by Sales & Perkins. In the shaft sunk on ; Perkins's property the lode is found to dip 78° northwest.

alhoun, located about 80 feet south of the former, belongs to the arties as the foregoing lode. In the west shaft, which is 25 feet n overseam of 12 to 20 inches is exposed. At the point of dis- the lode is three feet wide, and in the west shaft, which is sunk pth of 40 feet, four feet of quartz, dipping 78° northwest, are

Near this lode the slates are intersected by syenitic rocks. At : of intersection a lode of white quartz has been discovered and the *Mary Ellen.* Some very rich ore has been taken from the igs. The croppings of the northern part of the lode, here owned se & Co., lie nearly horizontally, but a surface pit 10 feet deep i, commencing at the depth of four feet, a dip of 35° to the north. inging wall consists of slates, the foot-wall of syenite. It is re- that some of the ore from this mine has yielded as high as $104 on in Pease & Co.'s arrastra.

his lode 1,200 feet south of the discovery stake are owned by ; Perkins. Their shaft is 22 feet deep and exposes the vein dip- r the first 20 feet at an angle of 30° and afterward of 75° to t. The bearing of the lode makes a considerable bend, as far as l to view by the present workings.

Plutus lode is located in the slate west of the Mary Ellen. The is exposed to view by a surface pit four feet deep, and consists ite feldspathic rock containing some malachite. The vein dips thwest.

Duncan lode is the next one west from the foregoing. It was dis- l and recorded August 21, 1868, by Ramsey & Stack, who have shaft 20 feet deep. The lode is nearly vertical, but at the bot- the shaft it seems to assume a northerly dip. About 12 tons ore have been taken out. A pretty gulch with a splendid spring r is near the discovery shaft. On its east side a tunnel had been iced on the lode. The ore taken out is of the same kind as that h in the shaft.

Barnaba, on the west side of the gulch, is opened by an adit, g a smooth foot-wall. The vein dips 82° northwest.

ie lodes above described lie in Shoshone mining district, south of reek, which forms the boundary line between Shoshone and Cal- listricts. In the latter district a range of hills, called Buckeye riboo hills, contains a number of lodes, some of which are very ng. Near them and in a gulch running parallel to the chain of n Atlantic City is situated. On the south side of Buckeye Hill, iree-quarters of a mile from Atlantic City, the *Soles & Perkins* s been opened by a shaft 5 by 10 feet and 60 feet deep. It is licular for the first 35 feet and then follows the dip of the an angle of 65° south. At its bottom two ore seams of respec- ur and sixteen inches are found. The hanging wall comes east it, and is well defined. About 140 tons of ore have been ex- 50 of which are on the dump awaiting reduction. The ore con- dark colored quartz, the sandy and soft varieties of which are han the hard ores. The average of the quantity already worked ween $30 and $40 per ton. Fifteen hundred feet west and 700 feet east of the discovery shaft is the property of Messrs. Soles Perkins.

The Buckeye State lode, situate about 700 feet north of the precedi one, is owned by Marshall, Forest, and others, to the extent of 1,0 feet east and 2,000 feet west of the discovery stake. The croppings a layer of quartz four feet thick, from which the owners are said to h taken about 200 tons of ore. In a shaft 60 feet deep the strike of vein appears to be north 40° east; the dip is first 45° northwest, t perpendicular. The yield of the ore worked in the Buckeye Compan arrastra is reported by the owners at $40 per ton.

The Julian lode on the southeast slope of the Buckeye Hill is ope by a surface pit 12 feet deep. The quartz vein exposed is five feet w and dips 30° northwest. Forty tons of ore have been hauled to Ric Co.'s mill, to be worked as soon as it commences operations. This was erected by the owners from the proceeds of gulch mining on B Creek.

The *Chinook lode*, about 400 feet northeast of the Julian, is eight f wide. Its course, exposed by a surface pit nine feet deep, is here nor easterly; it dips to northwest into the hill. About 30 tons of ore, pected to yield from $15 to $20 per ton, are on the dump. The claim 1,200 feet long.

Passing Chinook ravine, *Montana lode* is next met with on the sou side of Cariboo Hill. It dips about 70 degrees northwest into the hi The discovery shaft is only nine feet deep, no other work has been pe formed on the lode.

On the *Cariboo lode* Pease & Co. own 1,500 feet west, and Rice, M ler & Co., 1,100 feet east of the discovery stake. On the property the first-named parties the lode is 12 feet wide at the surface, and on 5 feet in the bottom of a shaft 30 feet deep. The dip of the foot-wa is 60°, that of the hanging wall 75°. Three shafts of a respective dept of 18, 25, and 30 feet have been sunk on the claim. The first 15 ton taken out yielded as much as 110.50 ounces of very fine gold; 60 ounces of this were sent to Sacramento, and assayed at Waters's assay office. The gold was found to be .902 fine. About 50 tons of ore were worked in Pease & Co.'s arrastra and are reported to have yielded $5,000. On the east claim the owners have sunk a shaft 15 feet deep, from which they took 100 tons of quartz. Twenty-seven tons, crushed at the Hermit mill, are reported to have yielded at the rate of $22 currency per ton. East of the Buckeye Hill, on both sides of Atlantic Gulch, two large veins, the Mammoth and Atlantic, have been traced for a considerable distance.

The *Mammoth lode* was discovered September 9, 1867. Three thousand feet on it are owned by Bolivar, Roberts & Co. On the first extension west, the Mammoth Company, Colonel Elliot superintendent, have sunk a shaft 70 feet deep, which exposes the lode 15 feet wide and quartz in its whole width. A considerable quantity of quartz has been taken from the shaft and a stamp mill will soon be erected.

The *Atlantic lode*, about one quarter of a mile above the Mammoth and running nearly parallel with it, has been traced for about two miles on each side of Atlantic Gulch. It is over 20 feet wide and carries huge croppings of quartz. The discovery and recording of the lode date back to September 9, 1867. Several companies have formed to work it. The Hope Company owns 1,800 feet, known as the Mills location. Eddy & Co. have located a claim of 2,600 feet, west of Atlantic Gulch, and their shaft is 70 feet deep. The Colonel Lewis Company *joins* the Hope Company on the east with 600 feet. Five tons of or om this lode are reported to have yielded $18 85 per ton. A 30-stamp ill is about being erected to work the ores, which are so abundant and easily extracted and treated that by working on a large scale a yield f even less than $10 per ton will pay.

Between Atlantic Gulch and Rock Creek, Lamaroux & Wilson own he *Golden Leaf lode*. They were testing their ore in an arrastra; the ult was not known at the time.

The *Silas Wright*, *Lone Star*, and *St. Lawrence*, near Anthony's saw-ll, on Slate Creek, have been opened by shafts. Ore, yielding from 13 to $15 per ton, has been extracted from the Silas Wright, the shaft which is 20 feet deep.

The St. Lawrence shaft is 30 feet deep, and the ores contain gold, sil-r, and copper. The Lone Star shaft, 45 feet deep, shows a lode of three d a half to four feet wide. It is owned by Davis, Colloms and others, d was discovered and recorded November 25, 1867. The Emerald e, being similar in character to Lone Star, is supposed to be an exten-n of the same.

he *Miner's Delight lode*, traversing Spring Gulch near its head, and ut 1,000 feet above the town of Hamilton, is owned, to the extent of feet southwest of the discovery shaft, by Frank McGoven, J. Hol-ok, J. L. Walsh, and others. The discovery shaft is located on the side of the gulch. It is 50 feet deep, and was accidentally burnt a rt time ago. About 100 feet southwest of this shaft, a second one been sunk to a depth of 100 feet, and about 130 feet still further on third shaft, 65 feet deep. Two horse-whims have been constructed oist ore and water. After the addition of the second whim, it possible to keep the water down; it had troubled the miners much before, and even forced them to stop sometimes. At the om of the last mentioned shaft a cross cut leads to the lode. Drifts been started, one 20 feet to the southwest, the other 25 feet to the heast. The lode is here three and one-half feet wide on an average, carries excellent ore from wall to wall. About fourteen inches of nsists of white, transparent quartz in loose pieces. Coarse parti-of gold can be distinguished in it along the whole length of the . The balance of the lode consists of decomposed quartz, resem-g shale, of dark color and very rich in gold. At a depth of 25 feet the surface, a drift, 105 feet long, has been run northeast in the tion of the main shaft. The main and discovery shaft are connected depth of 50 feet by a drift, from which the ore has been worked y back-stoping up to near the surface. Fifty men, at $5 per day, usually employed by the company to sink, drift, and stope. The h of the ore streak in the southwest part of the vein varies from nches to five feet. It has been found that the ore is richest in the west parts of the lode.

e northeast claim on this lode, 600 feet long, has recently been ht by W. D. Matheney for $50,000. It is here six feet wide, and a quantity of ore had been extracted and worked out at the mill ious to the sale.

e *Bennet Line lode*, between Spring Gulch and Yankee Gulch, has opened by a shaft 50 feet deep. The lode stands first perpendic-and assumes at a greater depth a dip of 75° east. Its course be-early north and south, the continuation of it would meet the Mi-Delight on the west side of Spring Gulch. One foot in width of re, consisting of white quartz, is said to be very rich.

e *Worldbeater lode*, in the same neighborhood, is so far, really innocent of beating the world. The quartz it contains is two to two an one-half feet wide, and lean.

The Miner's Delight mill has ten stamps, and is driven by a horse-power engine, which uses two and one-half cords of wood per da The stamps weigh 425 pounds each, and crush from 10 to 12 tons of per 24 hours. They are geared to fall 14 inches, at the rate of from to 70 drops per minute; 70 for hard and 40 for decomposed quart The tailings lost here are very rich in both gold and quicksilver.

This mill has been running all the time from January 14, 1869, July 5, with the exception of only twenty-five days used for cleaning and repairing. It is owned by Holbrook, McGovern & Walsh. The charges for hauling and crushing a ton of ore are $15. The ore work so far, has averaged about $40 per ton; some of it yielded as high $200, some only $16 per ton. It is estimated that the mill has tracted from $60,000 to $70,000 worth of gold from ore taken out of th Miner's Delight lode.

The third mill, put in operation on June 25, 1869, was brought to th Sweetwater mines from Colorado, and is a 10-stamp mill, belonging Anthony & Irwin. It is situated at Atlantic City, and run by an horse-power engine. The stamps weigh 450 pounds each, and drop ve slowly. Seventy-five tons of ore crushed here from the Soles and Pe kins lode yielded $1,711 in bullion, or at the rate of nearly $30 curre per ton.

Table of stamp-mills in operation, under construction, and on the way to the mines.

Name.	Number of stamps.	Drop in inches.	Weight of stamps.	Remarks.
1. Hermit	6	8½	650	In operation.
2. Miners' Delight	10	14	425	In operation.
3. Anthony's	10	....	450	In operation.
4. Elkhorn	10	....	....	Nearly complet
5. Young America	10	....	....	Nearly complet
6. Kidder & Mason	10	....	....	Nearly complet
7. Rice & Co	5	....	....	Nearly complet
8. Collins & Co	10	....	....	On the road.
9. Collins & Co	10	....	....	On the road.
10. Wheeler, Hall & Jeffers	20	....	....	On the road.
11. Wheeler, Hall & Jeffers	40	....	....	On the road.
12. Mammoth Company	20	....	....	On the road.
Total	161	....	....	

GULCH MINING.

Gold has been found in nearly every gulch in the Sweetwater distric but the attention of miners being more prominently directed toward prospecting for lodes and quartz mining, gold washing has been rathe neglected so far. Several gulches, however, as for instance Spri Gulch, Cariso Gulch, and several claims on Rock Creek, have been an are worked profitably. The gold dust is generally rough and rounded off, showing that it has not traveled far. Very little is, indeed found at any considerable distance from the lodes. Near the vein however, the claims are usually very rich.

The inclination of *Spring Gulch* is only five degrees. McGovern Co. have worked in this gulch for some time. They have taken out much as $220 a day with three hands; but during last summer th general drought prevented operations to a great extent and left them only a few inches of water. The pay gravel is about three feet thick ıd only a few feet below the surface. The largest nugget taken weighed x ounces.

Yankee Gulch and *Meadow Gulch* run parallel to the foregoing. They e rich in gold, but the lack of water prevents them from being worked present. It is reported that all the above-mentioned gulches can be pplied with plenty of water by a ditch to be run from Beaver Creek. The diggings in *Willow Gulch* prospect in spots as high as six and ght cents to the pan; the general average, however, is about $3 per y to the hand.

The claims on *Cariso Gulch* and *Rock Creek* have paid well. Some ld has been taken from Atlantic, Hermit, and Smith Gulches; but on e whole, gulch mining is still in its very infancy in the Sweetwater strict, and a large field remains open for prospectors.

The following is a more detailed statement in relation to the productveness of the different gulch-mining claims, and a list of the mill itches on Rock Creek, above Atlantic City.

Smith's Gulch, between Atlantic City and Hamilton.—First claim, above e road, 3 men wash out 4 ounces 16 pennyweights per week; 2d aim, below the road, 3 men wash out 6 ounces per week; 3d claim, elow the road, 6 men wash out 18¼ ounces per week, (a nugget worth 34 was found in this claim;) 4th claim, below the road, not worked at resent; 5th claim, below the road, 2 men wash out 4 to 5 ounces per eek; 6th claim, below the road, 2 men wash out $50 per week; 7th laim, mouth of Atlantic Creek, 4 men wash out 6 ounces per week.

Rock Creek, below Atlantic City.—First claim produces $3 50 to the and per day; 2d claim, below, belonging to Rice & Co., $12 to the and per day; 3d claim, below, belonging to Rice & Co., $8 to $10 to he hand per day; 4th claim, below, George Wilson proprietor, proluces $10 to the hand per day.

Mill ditches on Rock Creek, above Atlantic City.—They are given as ey succeed each other, commencing with the lowest one. 1st, Pease Co., 126 rods long, with arrastra; 2d, Tatler & Monroe, 132 rods long; , Spring & Wilkenson, 160 rods long; 4th, H. Hahn and M. G. Pohl, 50 rods long; 5th, Rice & Co., 10-stamp mill, with turbine waterheel; 6th, Buckeye Company, 140 rods long, with arrastra; 7th, open; th, H. Hahn, M. G. Pohl & Co., claim 1,200 feet, no ditch yet.

MISCELLANEOUS.

Miners' wages are $5 currency per day; surface laborers receive from 50 to $4. Lumber costs from $50 to $100; mining timber, seventye cents to one dollar for a twenty-foot log, or $5 to $10 per cord, deered at the mine. Common powder costs $10 per keg; quicksilver, 0 to $100 per tank, or $1 per pound; wood, $3 to $5 per cord. A -stamp mill, California pattern, including freight, cost of erection, ., costs $15,000; a 20-stamp mill, $20,000. Minimum cost of mining e ton of ore is $2; the average, from $5 to $10. Minimum cost of duction at the Hermit mill is $2 for hauling and $3 for crushing.

BULLION.

The gross amount of bullion extracted in the Sweetwater mining strict during the year from July 1, 1868, to July 1, 1869, is estimated, cording to the best information obtainable, to be $155,000 coin.

This sum total is certainly small in comparison with the amounts of llion produced by the neighboring Territories of Montana, Idaho, and Colorado; but it becomes large when we consider that it is the opening industry of a country which but two years ago was an unknown and unexplored desert, remote from the civilized world, and practically inaccessible. The fact that a small number of poor miners have brought this gold to light by their own nerve and persevering energy, unassisted by capital, suffering from want of supplies and accommodations, and facing the most terrible Indian atrocities, speaks well for the value of the mineral resources of the district. Indeed, the pioneers of Sweetwater may be proud of the result of their labors, and the whole country may rejoice and thank them for having reclaimed such a valuable portion of the vast wilderness of the great West to civilization and industry. In return, it becomes the duty of the government to protect these men in the future against further Indian outrages, and to extend freely such general aid to them as is consistent with the institutions and laws of a democratic republic.

SECTION VIII.—COLORADO.

CHAPTER LI.

GENERAL REMARKS.

The Territory of Colorado, situated between the 25th and 32d meidians of west longitude, and the 37th and 41st degrees of north latitude, orms nearly a square, comprising an area of 106,475 square miles. It s divided by the Rocky Mountains into two nearly equal portions. The astern half, with the foot-hills on that side, embraces most of the cultiated agricultural lands. As yet, not many valuable mines have been ound in this part of the Territory, except the extensive coal-beds in efferson, and Boulder Counties. Denver City, a thriving town of about ive thousand inhabitants, the capital and the agricultural and commerial center of the Territory, is located at the eastern base of the mounains. At this point the plains, gradually rising from the Missouri River, ave attained an elevation of a little over five thousand feet. That ortion of them belonging to Colorado is well watered by the South Platte, Republican, and Arkansas Rivers, and their numerous tributaries. All along these rivers and creeks is found excellent agricultural land, ielding easily much more than the supplies required for the whole erritory. The following account of the crops raised in 1868 is furished, from personal knowledge, by Mr. W. R. Thomas, one of the editors of the Rocky Mountain News:

The following article places before the reader, in compact form, the facts and gures regarding mining and agriculture in Colorado.

The material was collected with great care and labor, and at no little trouble and xpense. The facts stated will be found as near correct as it is possible to ascertain em. and within rather than outside the truth.

The bullion product.—These figures are obtained from the express books of Wells, argo & Co., and show the amount of gold and silver bullion carried east by them dung the year. The amounts credited to each office do not include re-shipments.

Express Office.	Gold.	Silver.	Total.
orgetown	....	$64, 487	$64, 487
ntral City	$1, 651, 747	123, 730	1, 775, 477
nver	257, 744	9, 527	267, 271
Total	1, 909, 491	197, 744	2, 107, 235

These amounts do not include the gold and silver carried east by private parties, r that manufactured at home. For a correct estimate of the latter items no satisctory data are at hand.

Agricultural statistics.—The agricultural statistics which have been collected may be vided into two classes; first, the number of acres cultivated in certain valleys, with estimate regarding the crops raised thereon, and second, the actual crops of other lleys, as gathered from reliable sources.

Number of acres cultivated.

Valleys.	Wheat.	Corn.	Oats and barley.	Pot
Platte, above Denver	1, 242	395	800	
Bear Creek	605	40	421	
Cherry Creek	108	78	256	
Fontaine qui Bouille	1, 735	3, 105	1, 381	
Huerfano	1, 160	2, 950	232	
St. Charles	485	742	135	
Arkansas	2, 075	3, 524	484	
Total	7, 410	10, 834	3, 709	

Two or three small valleys are included in the Arkansas. Rye and buckwhe included in "oats, barley," &c.

Taking the following average: For wheat, twenty-eight bushels; for corn, tı five bushels; for oats and barley, thirty-five bushels, and for potatoes and misc ous vegetables, one hundred bushels per acre, the estimated crop of these valleys be as follows:

Wheat	2
Corn	2
Oats, barley, &c	1
Potatoes, &c	1

The remaining valleys were visited after the crop was gathered and the threshed, and the number of bushels raised was collected as far as possible.

Bushels of grain raised.

Valleys.	Wheat.	Corn.	Oats and barley.	P
Platte, below Denver	17, 564	3, 013	33, 024	
Cache-la-Poudre	5, 258	2, 125	25, 000	
Big Thompson	8, 206	3, 297	27, 441	
St. Vrain	21, 673	2, 075	31, 023	
Left Hand	10, 350	875	13, 707	
Boulder	46, 530	....	42, 001	...
Las Animas	19, 542	21, 385	6, 058	...
Total	129, 123	32, 770	178, 254	

The figures on corn and potatoes are far below the real facts. Coal Creek is in in Beulah, and several small valleys in the Las Animas. The corn and potat was not collected in the Beulah Valley.

Recapitulation.

	Wheat.	Corn.	Oats, barley, &c.	Pot
Bushels estimated from the number of acres	207, 480	270, 850	129, 815	
Bushels collected after the threshing season	129, 123	32, 770	178, 254	
Total	336, 603	303, 620	308, 069	

These figures given comprise the mining and agricultural statistics which appeared in a series of editorial letters during the year. They do, however, not sent the whole agricultural product of the Territory. Several valleys have not visited, among them Clear Creek, Bijou, Kiowa, Running, Plumb, and Mo Creeks, the Upper Arkansas Valley, the different valleys lying between the St. C and the Las Animas, including the Greenhorn, Upper Huerfano, Apishapa, Las Cuc and the country beyond the Sangre de Christo range in the San Luis Valley. crops in these various sections have been large, especially in small grain, and been possible to collect the figures concerning them, there is no doubt that thos given would have been increased at least one half.

of the crop reported.—The value of the crop for the sections given above at gov-
prices would be as follows:

Products.	No. of bushels.	Price per bushel.	Value.
....	336, 603	$1 80	$605, 885 40
....	303, 620	1 10	333, 982 00
barley..	308, 069	1 20	369, 682 80
&c	246, 447	75	184, 835 25
d..	....	....	1, 494, 385 45

nclude this summary by submitting an estimate of the agricultural products
hole Territory in 1868, which we consider nearly correct. We arrive at the
y increasing the figures on wheat, corn, oats, barley, &c., one half, and by
; the potatoes and miscellaneous crop. The table will then stand thus:

Products.	Bushels.	Value.
....	504, 904	$1, 008, 667 20
....	455, 430	500, 973 00
ry, &c	462, 103	554, 529 60
nd miscellaneous..	492, 894	369, 670 50
airy products	....	250, 000 00
....	....	2, 683, 840 30

Cyrus Thomas, in his report to Dr. F. V. Hayden, United States
st, says the crop of 1869, which is larger than that of any year
ing, is estimated at the following figures:
at, 675,000 bushels: corn, 600,000 bushels; oats and barley, (nine-
oats,) 550,000 bushels; potatoes and other vegetables, 350,000
. Total value, including that of the hay and dairy product, not
n $3,500,000. This is not far below the value of the products of
for the year.

vestern half of Colorado is not much known beyond fifty miles
e mountain range, though several parties of prospectors have
d the country at different times. Some placers and veins have
und but no mining has been done on a large scale, except in the
River district. Here the crevices of the veins are large, and the
ainly galena, assaying well in silver. Nuggets of silver, weigh-
n an ounce to a pound, were, according to Mr. Hollister,* found
ys of gulch mining, at the head of Ten Mile Creek and Blue River.
s of gold, weighing, in some cases, as much as 50 pennyweights,
so found. Some single pits, 20 feet square, are reported to have
from $10,000 to $20,000. The principal work now carried on in
strict is that of a Boston company, which is driving a cross-tunnel
Fletcher Mountain, to cut at considerable depth a large number
g galena lodes which crop out on the surface. The work is to
with a rock-drilling machine.

ction works are already in process of erection. The Lawrence
Mining Company are putting up a building for two reverberatories.
lum will have two more, and Mr. Yonley is now constructing a
est furnace. A wagon road from Georgetown to Snake River,
st Argentine, is nearly finished. From all appearances much
may be expected in that region during the coming summer.
ritory still further west is scarcely known, except as possessing

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*The Mines of Colorado, by O. J. Hollister.

a magnificent grazing country, with abundance of fish in the streams and game in the forests.

This report is more immediately concerned with the Rocky Mountain chain and its valuable mineral deposits. The beauty and grandeur of the cliffs and peaks, the loveliness of the parks and valleys, have been the frequent themes of poets, travellers and painters. In the pages of Bayard Taylor, Hollister, and Bowles, on the glowing canvas of Bierstadt, and in the enthusiasm of innumerable tourists who annually visit this magnificent region in search of health and pleasure, they have received such justice as mere description can bestow.

The highest elevation of the mountains in Colorado is about 14,500 feet—at Mount Lincoln, near Montgomery, in South Park. Pike's Peak and Gray's Peak follow, having, respectively, the altitude 14,300 and and 14,250* feet. The whole chain is abundantly covered with timber up to a line about 11,500 feet above the sea, and watered by large creeks, fed from the heavy snows of the summits, and containing an abundance of deliciously clear cool water. These streams, met with in every principal valley, afford during nine months of the year ample power for driving machinery. They exert a very beneficial influence on vegetation, causing the soil in those valleys to yield excellent crops, even at an elevation of nearly 9,000 feet.

In this connection I desire to call attention particularly to one of the worst abuses attendant upon the settlement of the mining regions and other portions of the West. I allude to the wanton destruction of timber. This reckless and disastrous practice was extensively prevalent in the heavy fir and cedar forests of Oregon and Washington nearly twenty years ago. Timber was so abundant that to many it seemed inexhaustible, and they took especial delight in its destruction. Hundreds of square miles were burned over in a single season, and vast quantities of the finest timber in the world, easily accessible for purposes of commerce, either totally consumed or rendered utterly valueless. The same waste is yearly going on in all the western States and Territories, and particularly in the mining regions on the Rocky Mountains. Mr. W. N. Byers, of Denver, who is familiar with facts and results in Colorado, has furnished me with statements on the subject, which my own observations confirm.

When that Territory was settled, some ten years ago, the mountain sides were found generally covered with thick forests of pine, spruce, fir, and other trees, most of them of small size and short body. A given space would not give a large quantity of lumber or wood, as compared with many timbered countries, but for that very reason it was the more valuable, and its economy of more importance, because there was no other source of supply. Generally, these forests were green and flourishing. Only at rare intervals could a track be found that had been burned over by the Indians, and the trees killed. To-day, certainly, one-third—possibly one-half—in all the settled portions of the Territory, are dead—killed by fire. And outside the settlements, in regions visited at long intervals only by prospectors, their tracks can be everywhere seen in blackened trunks and lifeless, desolate-looking hill-sides. During the dry, scorching latter summer, the eye seldom glances over the mountain landscape without seeing somewhere—often in several places—the dense column of smoke that indicates a burning forest. Some of this destruction is fairly attributable to accident, more of it to culpable carelessness, and yet more to criminal design.

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* These differences are too small to be perfectly established.

Another source of timber waste is in the felling of trees unnecessarily. ten a man, finding a good body of timber for lumber, will go to work d slash down hundreds or thousands of trees, thinking that some other n will come in with a saw-mill and buy his logs. Sometimes the stomer makes his appearance, but often he does not, until the logs rendered nearly, or entirely, worthless by decay and the ravages of rms. But even if the saw-mill comes, there is no effort at economy. nber is plenty; it belongs to the United States, and the pioneer "has good a right to it as anyone else." Hence, only the best is used. e tree that would furnish three saw-logs, and its top two cords of wood, it belonged to the logger or millman, in this case supplies but two s, and the ramainder is left to rot, or to be devoured by the fire that et out when the neighborhood has been skinned of its most valuable es. The saw-mill is pulled up and moved a mile, or five, or ten, to ther fine grove, where the same thing is done over again, and so on. At Central City, the oldest and most populous gold-mining center of orado, the consumption of wood for fuel is very large. A few years it was purchased for two dollars per cord, but the increased distance auling has advanced the price about one dollar each year, until now equently costs ten. Lumber has to be brought from twenty to forty s, and heavy mill timbers often much further. And to obtain these cles they are robbing and skinning districts that may at any day re- e their own timber just as much as Central City ever did. Denver, ch formerly obtained her supply of lumber within twenty or thirty s, now has to haul much of it sixty. Other examples might be cited, it would only be an accumulation of evidence. The question arises, here is all this to end?" And the answer of the denuded hill-sides, he dismal wastes upon the mountain slopes, with their millions of red trunks and ghostly whitened branches, is terribly suggestive. hat shall be the remedy? Government officers have tried to check waste of logwood by the collection of a stumpage tax, and some- s by stopping such operations altogether; but the reform is not per- ible, and the deputy marshals soon tire of the task. In fact they powerless. The entire standing army of the United States could not rce regulations against cutting timber upon government lands. The itorial legislature, years ago, enacted a stringent law for the punish- t of those who fire prairies or woods; but the records show no ex- le of its enforcement. Last summer, in a new mining district that formed, the miners, among other by-laws, adopted one, that any on firing the woods should be hung. They then nailed upon trees he borders of the district, upon all the trails leading thither, boards, n which were painted: "Put out your fires! Any person firing the er will be hung." No damage was done by fire in that district last , but some day a reckless dare-devil will probably fire the woods, to see whether or not he will be hung for it. The general govern- t has failed, the territorial government has failed, and Judge Lynch fail. to protect the timber. I incline to think the only course is, for government to put the lands in market, and sell them to settlers er rules now applicable to the location and perfection of homestead pre-emption claims upon agricultural lands, with this change: ere such locations are made upon mineral lands—so returned by dep- surveyors and the surveyor general of the district—the title con- d shall be a surface right only, which shall be absolute ownership, pt in relation to minerals. The ground shall be free to all prospect- who desire to search for minerals, and when such shall have been d, upon application to the owner of the land, the latter shall be compelled to convey to the miner such mine and room for working the same—similar in provision to the present law for the perfection of titles to mines—upon the miner paying therefor a just and equitable price for the land, without reference to the mine itself. The value of such land may be determined by appraisement by disinterested parties. Such a plan will soon put a stop to the waste of timber; settlements will keep pace with mining developments in the mountains. The timber once in the hands of private parties, precautions will be taken to guard it against destruction by fire; none will be cut down that is not needed; and once down, it will all be used up. At the same time, it will be in so many hands that prices will be kept down; wood will probably cost less than it does now. A great deal of ground upon such locations will also be brought under cultivation. There are very few quarter sections, even in the mountains, upon which there is not room for a wheat field, or at least a garden patch.

The climate is healthy and delightful. Even during the hottest season the nights are always cool and refreshing; the air is extremely pure, the water unsurpassed, and all natural influences such as must render a sojourn during the summer or autumn salutary to both mind and body. In the most beautiful sections of the country the additional attraction of medicinal springs is furnished to the invalid. Salt, soda, and sulphur springs have been discovered, and have become already the resort of visitors from Colorado itself as well as from the East. The completion of direct railroad communication will make them objects of great attraction, and sources of considerable revenue to the Territory. The principal basis of the prosperity of Colorado, however, will doubtless remain (agriculture apart) the vast deposits of useful minerals of almost every kind, which occur in nearly every portion of the Territory.

Among these, gold occupies at present the first rank. Until two years ago, nearly or quite all the bullion shipped was gold bullion, containing only a very little silver as an alloy. At that period were discovered the rich silver mines of Griffith and Argentine districts, Clear Creek County, and Mountain House district, below Black Hawk, Gilpin County. The silver product during the last fiscal year amounted to about one-sixth of the gold; but it is not unlikely that in three or four years it will have advanced to equal importance. On the other hand, the discovery of extensive placers in those portions of Colorado not yet thoroughly explored may keep the balance in favor of gold for a longer period.

During the first four years after discovery of gold in Colorado, there was shipped, according to several statements, more than $30,000,000. Most of it came from the rich placers of Gilpin, Clear Creek, Boulder, Summit, Lake, and Park Counties, some of which yielded enormously. A large portion was derived from the rich, decomposed surface rock of the prominent lodes. The richest gulch ever worked in Colorado was California Gulch, in Park County, discovered by Slater & Co. in 1859, and developed in the following spring. The whole gulch was at that time divided into three districts, called Independent, California, and Sacramento districts, and pre-empted in claims of 100 feet for a distance of nearly seven miles. According to a statement in Mr. Hollister's book, the following amounts of gold were obtained from the principal claims:

Discovery	$60,000
No. 1 below	55,000
No. 4 below	75,000
No. 5 below	55,000
Nos. 11 and 12 below	86,000
Nos. 26 and 27 below	50,000
Nos. 5 and 6 above	65,000

os. 14 and 15 above	$80,000
os. 19 and 20 above	80,000
o. 21 above	15,000

The product of claims 19 and 20 above the Discovery was obtained in hree months. Many claims not specified yielded from $3,000 to $5,000 ach, while the amount of daily yield per hand employed in different ections of the gulch was as follows:

os. 13 to 25 below	$10
os. 28 to 35 below	15
os. 36 to 41 below	25
os. 45 to 56 below	18

Many other prominent gulches yielded nearly as well; and even at resent some of them pay from $5 to $10 per hand daily. The gold now btained from the gulches, however, is a subordinate part of the whole roduction; and this fact should be borne in mind when Colorado is ompared with States and Territories where this comparatively easy ethod of mining still flourishes. The papers have recently announced he discovery of rich placers near the northern border of the Territory, ut I have obtained as yet no trustworthy accounts from that quarter. bout seventy per cent of the gold bullion is extracted from the aurifer-us pyritic ores of Gilpin, Clear Creek, Boulder, Park, and Lake Coun-ies; fifty per cent. or more being furnished by Gilpin County alone.

The principal gold-bearing minerals are copper and iron pyrites. hese mostly occur together; the latter, however, nearly always pre-ominates, and is often found without the former. When both are resent, the copper pyrites is always the richer in gold. At least, this the case in Gilpin County, to which this, and the following state-ents bear exclusive reference. A striking illustration is furnished in ussell district. The Pewabic, Kingston, Wantoga, and a few other odes contain pay streaks, several feet wide, and consisting chiefly of uartz, decomposed feldspar, iron pyrites, and a little copper pyrites, very nely intermixed. All these ores assay in bulk from $30 to $40 coin per on, while specimens containing a larger amount of copper pyrites assay 300 and over. Further evidence is found in the circumstance that the regory, Bobtail, Bates, and Briggs, considered to be the richest mines n Gilpin County, furnish the largest amounts of copper pyrites.

I do not yet consider the question as settled beyond doubt, whether he gold is contained in the pyrites wholly in mechanical, or partly in hemical combination. The weight of authority and experiment is in avor of the hypothesis of a mechanical admixture of fine particles of etallic gold; and those who incline to the opposite view have hitherto ailed to adduce satisfactory evidence for that belief. The gold in Col-rado is generally alloyed with small quantities of silver and copper. In ost cases, it is very finely intermixed with the ore; sometimes, how-ver, it is concentrated in streaks, bunches, &c., and every good lode has urnished, more or less abundantly, specimens showing large amounts f native gold, generally crystallized. The Winnebago lode yielded some agnificent ores, covered all over with finely developed crystals of the onometric system; some beautiful ones from the Leavitt contained the gold in wire-form, similar to its occurrence in Hungary, and in Santiam, Oregon, or to the occurrence of silver in the mines of Kongsberg, Norway. The Bobtail, Gregory, Bates, Briggs, German, &c., furnished many spe-cimens containing large needles of metallic gold; and one in particular, rom the Smith and Parmelee Company's claim on the Briggs lode, dis-layed a heavy streak of metallic gold, interwoven with a smaller streak of silver; a curious occurrence which has not been noticed, as far as I am aware, on any other lode in Gilpin County.

In many cases, especially if the copper and iron pyrites are mixed with a large proportion of zinc-blende and galena, the gold obtained by pulverizing and washing the ore does not present the usual characteristics. Instead of the bright yellow color and metallic luster we have a grayish brown, dull tint. In this condition, it is known as "rusty gold," and seems to be quite indifferent to the action of quicksilver. A large needle of native gold in this condition, from Bates ore, was weighed, and left for a long time in contact with mercury, but did not manifest the least change in weight. A subsequent melting gave a regulus of bright gold containing 99 per cent. of the original piece. This experiment indicates that there is a film of some other substance upon the surface of the rusty gold. Of course, this coated gold can be saved only to a small extent by the ordinary stamp-mill process. Roasting or other chemical treatment, or mechanical rubbing in pans, is required to remove the film, and leave the gold in amalgamable condition. The partial desulphurization effected by the many patent processes which have infested the Territory will not accomplish this. If roasting will do it satisfactorily at all, the operation must be carried far enough to destroy the sulphate of copper formed in the charge. The chemical nature of this coating has not yet been absolutely ascertained. The fact that so high a roasting is required to remove it clearly indicates that it is not sulphide of iron; while other circumstances would lead us to believe it to be oxide of iron. It is said that Mr. William Brückner has succeeded in removing it perfectly by roasting in his cylinders, with the addition of salt toward the close of the process. The theory of this experiment may be the formation of a chloride of iron, which is volatile at high temperatures. The great question still remains unsolved by practical operations on a larger scale, whether mere desulphurization will leave auriferous pyrites in a condition suitable for the extraction of the gold by amalgamation. Experience thus far is discouraging; but I do not doubt that some simple expedient will be discovered overcoming the difficulty. That such an invention is needed appears from the fact that chlorination and smelting, two processes which are acknowledged to be metallurgically perfect, are too expensive to be applied to a large class of ores, for which amalgamation will probably always remain the available method.

Copper occurs in the prominent lodes in considerable quantity. The first-class ores of some of the mines contain from ten to fifteen per cent. of it. It is almost always in the form of copper pyrites, a combination of sulphide of copper and sulphide of iron, containing, when pure, 34.4 per cent. of metallic copper. Near the surface this ore is found more or less decomposed and converted into carbonate and oxide; copper glance or pure sulphide of copper is reported from Bergen district, near Idaho City.

The amount of silver in the pyritical ores is usually very small, not more than $5 to $15 per ton. A small portion, alloyed with gold, is saved in the stamp mills; but by far the larger part, being in the state of a sulphide, which will not amalgamate, is lost.

Besides copper and iron pyrites, almost every lode carries a little zinc-blende and galena. In some districts, especially Quartz Valley, Nevada, Illinois Central, and Russsel, these minerals form a considerable part of the ore, while in Central City, Eureka, and Gregory districts, they are but subordinately represented. The zinc-blende is usually *poor* in silver and gold. Two samples, one from Quartz Valley, the other from Nevada district, gave, respectively, by assay, per ton—first, gold, \$5 98; silver, \$3 41; second, gold, \$11 96; silver, \$1 13.

The galena contains probably little or no gold; at least, assays have not discovered more than a "strong trace" in such pieces of galena ore as contained no visible copper or iron pyrites.*

In Colorado, as in other countries, it has been found that the gold is not uniformly distributed throughout the ore, nor the ore throughout the veins. There are rich and poor streaks; and of two pieces taken from the same mine, one may be many times richer than the other, though the eye is able to detect no difference between them. It has often been said that the Colorado gold ores grow richer, as a general rule, with increasing depth; but this is not true, though such has been the case in a few instances. Neither can I satisfy myself of the existence of a zone of "cap rock" or barren vein-stuff extending along the vein at or near the water level. It seems rather that the miners call every body of barren rock "cap;" and that one is quite as likely to get out of the cap by drifting as by sinking. The regularity of "chimneys," or bodies of rich ore in the veins, also seems to me a matter of some doubt.

For the extraction of the gold, the common stamp-mill process, with amalgamation in battery and upon copper plates, is almost exclusively employed, although it is generally admitted that only a portion of the precious metals is saved in this way. Amalgamation is, however, the only method by which the low-grade ores can be made to pay. The cost of this treatment is less than \$5 per ton, and for the surface ores it must be highly recommended, as it accomplishes for them all that is needed, in the cheapest possible manner. The complete failure of the stamp-mills in 1863 and 1864, when the surface quartz was worked out, and the pyrites reached, was without doubt largely owing to the inexperience of the mill-men; for the miners have now returned, after an interval of reckless and disastrous experiment, to the old process, which they operate profitably, in spite of the refractory ores. Skilled workmen and greater discipline and care in the mills have undoubtedly assisted this result. Yet it seems to me that greater efficiency could be attained with the machinery now in use than is actually the case. The strong and natural reaction in Colorado against new processes, from which the Territory has suffered so much, has gone so far as to make the mill-men obstinately refuse to adopt even the well-proven apparatus of other regions. In the matter of the speed of stamps, there is a singular prejudice in favor of very low rates. I have frequently seen steam-batteries geared to run at 18 drops per minute, and the average speed is not greater than 25 to 30. In other districts of the West, stamps of equal weight are run generally at 60, and frequently as high as 100 drops per minute. The reasons given by the Colorado mill-men are plausible, but they do not, in my opinion, meet the case fully. A recent article in the Central City Register, presenting their side of the question with ability and in an excellent spirit, will be quoted in the next chapter.

The process-mania, commencing in 1864 and lasting till 1867, was one of the main causes which damaged the reputation of the mines to such a degree that the country was nearly ruined by the reaction. Upon the first failure of the stamp-mills, people came to the conclusion that the ores must be roasted, before the gold could be amalgamated. One invention for this purpose followed another; *desulphurization* became the Abracadabra of the new alchemists; and millions of dollars were wasted in speculations, based on the sweeping claims of perfect success put forward by deluded or deluding proprietors of patents. The amount of money lost in actual experiments was much less; but it was considerable, and a great deal of it might have been saved, if the subject had been carefully investigated by a commission of experienced men, instead of being left to isolated experiments, conducted by interested parties, and observed and recorded by good-natured newspaper reporters or awe-struck greenhorns. The intelligence of the persons managing the mining companies can, in some cases, only be vindicated at the cost of their honor. In many instances, a little excitement about the reported success of a new process gave just the assistance required to put life into the stock-market, and enable overloaded holders to relieve themselves. The premature exultation of the inventor and his assignees, before any working tests on an adequate scale had been made, and the haste with which a complete success was usually announced, before an impartial and disinterested observer would have dared to draw such a conclusion, were suspicious elements of many such undertakings; and the wretched consequence of the whole matter was a failure of many companies, and the partial or complete suspension of operations on the part of some, influenced by the hope that others might, at whatever cost of failure and disaster, finally solve the problems involved, and thus point out the safe road. In surveying the record of these unfortunate years, one is impressed with the conviction that a short-sighted selfishness and lack of harmonious co-operation has been one of the great causes of unnecessary expenditure of time and money. One portion of the mining community engaged in experiments, the true results of which were rarely made known in a form to be useful to other inquirers, and another portion passively waiting till the desired benefit should drop into their mouths—this was an antithesis almost fatal to general progress. Yet progress was undoubtedly achieved, and there are, I believe, abundant materials for a treatise on the methods of extracting gold from sulphuretted ores, only needing careful collation and digestion. Upon this labor I have been for some time engaged; and I hope to consider this subject as a whole and at length in my next annual report.

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*This fact is reported by Mr. A. Wolters, now superintendent of the Baker mill, near Georgetown, but formerly practicing as a mining engineer and metallurgist in Central City and Georgetown. I have acknowledged my indebtedness to this gentleman on a former page; but I desire to say here, that a large portion of this section is based upon the extremely full, intelligent, and accurate notes furnished by him.

Another cause of failure in former years was the outrageous value placed upon undeveloped mining property. This was only possible by virtue of general ignorance on the subject of the difficulties to be encountered. The prevailing belief that all the mines in a district were equally good, and that the amount of profit to be reasonably expected might be calculated at once from the dimensions of the lode, reduced to tons of rock, multiplied by the assay value of specimens, and diminished by a trifling amount as "expenses," led to great looseness of management. The anticipated magnificent gains would cover all minor extravagances; so capital was wasted; stock was watered; large salaries and high wages were paid, without a thought of the inevitable result. Now, all these things have been changed. Large sums are no longer paid for the mere chance to mine, and the business is administered as any other should be, with care and economy.

Moreover, the miners of Colorado were inexperienced in deep mining, and they made sad work with it at first. Even now there are few well-opened mines in the Territory. The prevailing deficiency is in prepared stoping ground, permitting increased production. There are too many companies, too many shafts on the same vein, and the levels are freuently too close together. These evils were formerly much greater, nd combined with those already mentioned, and the rebellion, the Inian troubles, and the long and severe drought, they account for the emporary depression in mining industry.

On the other hand, there is abundant evidence that the mines themelves are not to blame. I am sometimes even surprised that they have ielded so much as they have; they will prove equal to those of any other ountry. Mining is a business, full, at best, of difficulties and risks; and is the part of wisdom to secure at the outset as many of the chances s human foresight can perceive, or human skill control. When a man ngages in this business with all the chances against him, it requires no rophet to foretell the result. Among the mines which never did pay nd never will, I unhesitatingly include those that have no existence. here have been in Colorado a great many Hamlets with Hamlet left ut. It need not be said upon what shoulders the blame should fall. erhaps it is about equally divided. If eastern speculators have badly urnt their fingers, some of the miners have been well plucked in reurn. It is but seldom that sympathy is required for either side. All peculation aims at getting a thing for less than it is worth, and selling for more; and pure mining speculation—the system which looks not the steady development of a country, but to shuffling off the burden its development upon successive shoulders—is not deserving of sucess. The purchaser of stock in one of these paper companies is only nxious to raise the value of the stock and get rid of it; and often he a fool, because he tried to be a knave and failed. It is like the pocket-book" game in our eastern cities. If the stranger upon whom is tried is a thoroughly honest man, it fails; but if he is just sharp nough to pay twenty dollars for the chance of getting a hundred out the pocket-book skillfully left for him to find, he falls a prey to his wn acuteness and unscrupulousness, and we do not pity him when his rize turns out to be brown paper, tipped at the ends with counterfeit otes.

To the important questions: "How came those mines that once were rofitable to fail? What is the secret of the present success of others? ow can many now idle be restored to an active and fruitful condion?" there are no general and universal replies. We might as well sk why one merchant fails and another succeeds. Some merchants uin themselves by their own extravagance and incompetency; some mbark in a business in which failure is a foregone conclusion, circumtances being from the outset against them. If we consider, however, the axim, abundantly illustrated, that bad management will ruin any mine, owever valuable it may be, we may say with confidence that bad manageent has done more to injure mining in Colorado than all other causes ogether. And this bad management has been four-fold—in laws, in the xtraction of ores, in the reduction of ores, and in general finance. Here, o, the blame must be divided. Incompetent agents have doubtless wasted oney, but they have generally acted under advice. Scientific men, so alled, have made stupendous mistakes of judgment; but they have been urpassed by the blunders of practical men, so called. The scientific men ithout practice and the practical men without science, the honest men ithout capacity, and the smart men without honesty, have done so uch to destroy the mining industry in Colorado, that the very fact of continued existence, after so terrible a trial, is proof of its inherent tality and future prosperity. This year marks the new era of mining Colorado. The old spirit of idleness and speculation has passed ay. The new spirit of labor and economy has sprung into power. It is beginning to be recognized that the men to develop the resources of a country are the men who live in it; that the foundation of wealth is labor, and that only; that capital is only the hoarded labor of the past, loaned to the labor of the future; and that, under all, before all, above all, if there is to be progress, there must be work!

The days are passed in which mere high-flown compliment or vague prophecies of gain could satisfy the people. Out of the stern lessons of the experience of the last six years, they have gained a knowledge of the difficulties with which they have to contend; and any man who evinces an intelligent perception of those difficulties, and professes the ability to suggest any means of assistance, will command their attention. This is the close of the era of selfish, reckless, individual activity, in which every man, whether miner, merchant, or ranchero, sought only to make quickly, by fair means or foul, a fortune for himself, and then escape from the country. Colorado is now filling up with men who *mean to stay*, and desire, therefore, honorable reputations for themselves, and good order and prosperity for the community.

It should be pointed out, and it is susceptible of the clearest proof, that the general impressions of the miners concerning the supposed immense profits of reduction works are entirely erroneous. The smelting works at Georgetown were unable to carry on business profitably, even when receiving the large price of $100 per ton for the treatment of custom ores. Huepeden and Stewart are unable to underbid each other, because a competition at present would ruin both. It is very easy to peep in at the door of a metallurgical establishment, count the number of workmen, estimate the consumption of fuel, and decide that the proprietor must be making one hundred per cent. on his investment; but in a country where capital commands, on good security, twenty-five to thirty-five per cent., the management of a business requiring capital is cumbered with a thousand expenses, not appreciated except by the proprietor. Every delay for lack of ore or by reason of repairs is a double loss. The shipment of bullion is costly. Materials are more than costly. Mr. Huepeden, during my visit, hunted through Denver, Central, Georgetown, and other places, in vain, for a single article—merely round bar iron of a certain, very ordinary size, for bolts. When ore is purchased by assay, as at Hill's works in Black Hawk, a new and most oppressive expense is added. Professor Hill not unfrequently waits six months for his returns from ores for which he paid in cash. In view of all these circumstances, I do not hesitate to say that not one of those who grumble so loudly at the extortion of the owners of reduction works would be satisfied with the rate of profit upon capital invested which those works have realized. To all this add another circumstance, the force of which is overwhelming. So long as comparatively little capital has been invested in mines, the miners are not held to perseverance by any particular tie. A temporary discouragement, or, still more frequently, a new and promising discovery in some other region, and a consequent stampede, may half depopulate a district, and completely dry up those little sources of the supply of ores, the aggregate of which would perhaps furnish a respectable basis for reduction works. The miner takes his pick and shovel and sets forth to seek his fortune, leaving nothing behind more valuable than an old windlass or a hole in the ground. But furnaces and cylinders and heave machinery, and costly foundations, and dams, and flumes, cannot be so transplanted. The owners of such works are therefore situated in some degree as was the Atlantic Telegraph Company when the new cable first began to work successfully. Burdened with the great outlay of construction, and uncertain w long their prosperity might continue, they were obliged to establish gh rates at first; but these rates were reduced as the risks grew less, d the prospects of the future become more certainly assured.

The sum of the whole matter is this: The owners of reduction works Colorado (outside of ordinary stamp-mills, to which I do not now fer) have a right at present to large profits; yet they are not realizing much as the capital they employ would bring in other ways. Their siness will be more profitable, even at lower rates, when the produc- n of ore has become regular and abundant; and the cure for existing ils is not the establishment of competing works, but the more system- ic and persevering development of the mines. There is capital ough in the Territory itself, without drawing on the East to produce is result. Money was freely subscribed in Denver, the other day, to ck up an old claim to a mine which had been made successful by par- s who innocently infringed (if indeed they did infringe) on the earlier hts of a discoverer who had long since abandoned his little pit. In her words, money can be had for piratical, destructive litigation, which withheld from regular and fruitful industry. This brings us to another il already active in Colorado. The old set of miners are to a large tent departed, but they have left a legacy in their abandoned coyote- les which occupy the places where more sober and persevering men uld now gladly expend their energies. But no sooner does any one ate a mine and begin its development in earnest, than, on the first ken of success, the phantom of a former claimant starts from the adowy past and clutches at the fruit of his toil. Every district in e West that, after its fever and chill of speculation, wakes to new and rious activity, finds this incubus on it.

The bullion export of Colorado during the year ending July 1, 1869, near as can be ascertained from the books of Wells, Fargo & Co., ounts to—

old	$2,500,000
lver	370,000

If we add the amount of bullion shipped in the shape of copper atte by Professor Hill, worth probably $200,000, the value of the rich lena ores shipped to New Jersey for treatment, equal to $100,000, and ally, the amount of bullion taken East by private parties, estimated $35,000, we obtain as a total amount of precious metals produced by e Colorado mines, the sum of $3,200,000 in coin.

For the next six months, from July 1 until December 31, I estimated e amount of bullion likely to be produced—

old	$1,500,000
ilver	300,000
Together	1,800,000

This estimate was made in August. It is now safe to say, that the llion product of the year 1869 amounted to $3,800,000. The governor f the Territory puts it at least a million higher; but that figure will be ore accurate if applied to the probable product of 1870.

CHAPTER LII.

GILPIN COUNTY AND THE GOLD MINES.

Mining in this county has so decidedly improved during the past year that it may be said to be at present in a more prosperous and promising condition than ever before. During the winter of 1868–'69, more stamps were running and more gold was produced than in any former year at the same time. With the opening of spring, operations were at once increased, and already, in May, over 800 stamps were running, and during that month $200,000 of bullion was shipped. In August, the monthly gold shipment amounted to $394,600, not including the product from Professor Hill's smelting works. I have already discussed the causes of the great depression of the mining industry in the whole Territory during 1865, 1866, and 1867. The Gilpin County mines were at once the most disastrously affected and the first to recover.

The country rock of this belt is gneiss or granite, in which the veins occur as true fissures. The surface is mountainous, intersected with numerous deep cañons and gulches, in one of which Central City is situated with Black Hawk below it and Nevada above. The forests which once covered the hills have been long ago cut away in the vicinity of the mines.

The gold veins have a general northeast and southwest course. They vary in width from a few inches to 10 or 15 feet. Two feet is not an uncommon width for the "pay rock." The minerals composing the ores, so far as they are connected with mining, have been mentioned in the foregoing chapter. The gangue is quartz with a quickly weathering feldspar. The oxidized and decomposed surface rock extends sometimes 70 or 80 feet below the surface. It is light and porous, consisting of a skeleton, as it were, of quartz from which the pyrites and feldspar have been decomposed and partially removed. Below this, the vein is sometimes found to be barren or pinched for a considerable distance, even to the depth of 200 or 300 feet. This is called the "cap," but its occurrence is a matter neither of certainty nor of regularity, and the name itself is vaguely applied to all vein material that does not pay for mining.

Some of the principal lodes have been traced for considerable distances, as, for instance, the Gregory, Bates and Hunter, Mammoth, Bobtail, Gregory second, and Gunnell, at Central City, and the Gardiner, with its extensions, the Mercer County, and extensions, and the Burroughs, at Nevada. The difficulty of identifying the continuations of veins is enhanced by the propensity of locators to give a new name to each discovery, assuming it to be an entirely new lode until the contrary is proved. This proof must be furnished either by actual continuous tracing or by the sinking of shafts from one claim to the other at intervals of not more than 50 feet, and the discovery of the lode in each shaft. A notion which formerly obtained, that the intervention of running water always cuts off a vein, has led to the application of different names on both sides of each stream crossed by the lodes. The following description of the most important groups of mines shows the small space into which they are condensed and the intricate relations of boundaries and titles, as well as the multiplied proprietorships, which form so great a hinderance to the success of mining. This description is taken mainly from the letters of a very intelligent correspondent of the Engineering and Mining Journal, (A. D. H., jr.,) which I have, however, altered as my own views or observations dictated.

The Gregory lode was the first discovered in this region, the finder being John H. Gregory, who, in 1859, followed up the creek until he ound the vein. It has been traced on the east nearly or quite to Chase Gulch. Thence it runs westerly over the summit to Bates Hill, down to Gregory Gulch, and up Gregory Hill to the Mammoth lode. The Bissell de has been supposed by some to be a continuation of the Gregory eyond the Mammoth. The Gregory has never been worked to any ex nt on Bates Hill, and, indeed, of the fourteen old companies possess g claims, only three, the Smith & Parmelee, the Briggs, and the Black awk, are now engaged in active operations, while a fourth, the Con lidated Gregory, is merely raising ore enough for the mill while wait g for an assessment to sink their shaft deeper. The general direction the Gregory lode was given me as 40° north of east, and the average p in the shaft of the Gregory Consolidated as 80° south. At the No. haft of the Black Hawk Company, the Foote & Simmons vein branches on the north side, running in a westerly direction and dipping to the rth. This vein to the east of the shaft, under the title of the Briggs le, coincides with the Gregory at the surface, but separates on get g some distance down; but here there is a disputed point as to which properly the Briggs and which the Gregory vein, one party claiming e Briggs and the other the Gregory, as the more southerly (and the her) of the two; that is, one claims that the Foot & Simmons crosses e Gregory, the other that it does not cross. The work now being done to the east of the junction, and on both the Briggs and Gregory afts have been sunk over 500 feet, and good ore is still found at the west depth in large quantities.

Northwest of the Gregory, up Gregory Gulch, the next vein which tracts the attention is the Bates, which runs nearly parallel with the regory. This commences on the east at Chase Gulch, crosses Bates ll and Gregory Gulch, and runs, now as the Bates and Hunter, and, rther along, as the German, up Mammoth Hill to near the Mammoth le. On this vein, which has been worked in places to the depth of 0 to 300 feet, and on which some ten companies own property, the tes and Baxter claim is being worked on a lease, the Union Com ny is operating, and some work is going on at the German; otherwise, is quiet. This lode seems to carry more galena than the preceding, hich it otherwise resembles. Following up Gregory Gulch, there is on tes Hill another lode which is not being worked, although traced on e east beyond the summit of the hill and on the west to the gulch, d apparently running into the Bates and Hunter. I could not ascer n anything definitely about this vein, but was informed that it was led the Molasses in part and the Morgan in part, and that some "sharp ctice" and bad mining had caused its abandonment. The last vein Bates Hill is the Gregory second; this runs from Gregory Gulch up r the hill, and has perhaps been traced east as far as Chase Gulch, possibly beyond this. No work appears to be going on upon this lode. ut opposite the Gregory second on Mammoth Hill is the U. P. R. , owned by one party. This is worked, and pays well. But there suit with the Kipp and Buell, a company owning a lode further up hill, the Kipp and Buell claiming that the westerly end of the U. P. R. into and coincides with their vein, while the other party claim that can trace the Kipp and Buell vein crossing theirs and running more e east. The matter is before the court and will remain there, un tedly, some time. The U. P. R. appears to run more nearly north south than the neighboring veins, quite a number of which it cuts, to descend nearly perpendicularly.

he Mammoth lode runs over Mammoth Hill about east-northeast and west-southwest, being traced on the west nearly to Spring Gulch, being generally supposed to be on the east of the same vein as the tail. It is of greater width than most of the veins, and is filled wi compact mass of coarse pyrites, which, however, as far as worked, too poor in gold to pay, although one or two parties are still sinkin the lode in hopes of finding better ore below. The Bobtail runs nearl and west with a small dip to the south, and is claimed to be the ri of all the veins just around Central. Most of the mines are drowne at present; the Bobtail and the Sensenderfer are at work, but on the upper part of the load on account of the water. An effort is made to consolidate the various companies owning claims. The north of the Bobtail, and lower down on Bobtail Hill, is suppos run into the last named vein and with it to form the Mammoth The last of the lodes at Central to be mentioned here is the Gunn Nevada Mountain, running nearly east and west and dipping t south. On this once famous lode no work is being done at present property having passed into the hands of stock companies, which, general thing here, have proved to be failures.

At Nevada the principal lode is the Burroughs, which has been thoroughly developed, perhaps, than any other vein in the country with a better average production. It runs nearly east and west with to the south, and has been traced, apparently, for a very considerabl tance. The vein has been worked for a length of about 2,400 feet, depth varying from 220 to over 600 feet, the deepest workings bein the Ophir mine, where two shafts have been sunk 575 and 635 fee spectively. The "surface quartz" appears to extend down about 30 quite regularly, but the "cap rock" very irregularly, from 125 to feet from the top. The ore at the lowest depths does not appear as as above, at least at present, and either for this or for other reasons of the mines are doing but little work.

Nearly parallel with the Burroughs run the Gardiner and the M County veins. These are doing but little although one or two are prospering. The Flack, on the westerly termination of the M County; the Forks, on a vein running across from the Flack to th diana, (a continuation of the Gardiner,) and the California, on the of the Gardiner lode, are the most prosperous at present of all at Nev The California mine is one of the handsomest and best worked in rado. The engine shaft has been carried down about 475 feet, pas first through about 90 feet of surface quartz, then through 180 fe cap rock, and then reaching ore which yields in the stamp mills tw to fourteen ounces of gold to the cord, (about eight tons.) To the an old shaft, not worked now, runs down 95 feet in surface quartz; still further east another shaft is down about 300 feet, passing thr 85 feet of surface quartz, 50 feet of ore yielding about four ounces t cord, and then through the richer ore. Several drifts have been run, there is exposed a very large amount of apparently rich ore, (tw ounces to the cord.) The width of the "pay rock" is from three to feet, and some five cords of ore are raised daily. About one-tent the ore is said to be smelting or first-class ore, and worth $50 to to the ton. The mine is very lucrative at present, according to accounts.

The Prize and Copeland lodes are worked in one mine, at Nevad a considerable depth. Zinc-blende predominates in the ore. Accor to Mr. P. Frazer, mining engineer, who examined this mine in Jul August, the vein at the bottom of the shaft (below the union of the *lodes)* is six feet thick, and carries an 18-inch pay-streak on either

Seventeen men and two horses are reported to raise 21 tons of ore daily, supplying 24 stamps with second-class ore, yielding six ounces gold to the cord, while the first-class ore is said to assay $100 per ton. If this is really from the zinc-blende, the occurrence is a remarkable one, being contrary to the general experience of the district.

The Perrin Mining Company, under the charge of Mr. G. A. Bradley, has vigorously pushing forward the opening of its mine, and the construction of its mill, at the time of my brief visit to Colorado. Mr. Fraer, of Dr. Hayden's corps, visited the works somewhat later, and found them just going into operation. From his notes the following account is taken. The shaft of this company, on the Perrin lode, is situated in Russell Gulch; it is 140 feet deep, and shows the dip of the vein to be 78° and the strike north 5° east at the shaft mouth; but the strike varies with the distance from the shaft. No good hanging wall has yet been reached. The mill owned by this company is located about a quarter of mile from the shaft-house in Russell Gulch. There are four companies running mills in the gulch above this one, which purchase their water from the Consolidated Ditch Company. This company brings water from Fall River, a stream west of North Clear Creek, and the supply it affords is limited, though the use of proper reservoirs would economize it. Mr. Bradley, however, has a drain to Graham Gulch, and leads the water thus obtained to a tank of 1,200 cubic feet capacity. A cistern containing five barrels, attached to the rafters of the mill, keeps the stamps supplied with water, and is itself supplied by pumps from the tank. To provide against a failure of this water supply, there is a second tank, of 288 cubic feet capacity, placed at the opposite end of the mill. to receive the water from the tail-sluices. This tank is unequally divided by a partition not quite as high as the sides, over which the water pours from the smaller into the larger portion, thus clearing itself. An elevator conveys it back to the cistern. In this way the same water can be used several times. The mill building is 40 feet square, and contains two 6-stamp and two 5-stamp batteries. The stamps of the former weigh 600 pounds each, and those of the latter 450 pounds each. The former are intended to drop 25 times per minute, and the latter 35. The two 5-stamp batteries are set to one cam-shaft, so that they are always run together. The 6-stamp batteries can be run separately or together, as desired. The pulp escapes over eight feet of coppers and eight and a half feet of blankets, the latter being washed, according to circumstances, once in fifteen to thirty minutes. The tailings are treated in Bartola pans.

The arrangements of this mill are highly judicious; permanence, convenience, and economy having been united in a remarkable degree. At the same time it should be remarked that not all its peculiar features are due to the deliberate planning of the superintendent. He has secured. at low prices, some good machinery, imported into the Territory for other and now extinct companies; and the skill with which he has adapted this to his general plan is to be admired, while the selection of the particular patterns is not to be held as an expression of his impartial judgment, as it would have been exercised in ordering new machinery. I believe this to be the secret of the general use in Colorado of the Bartola pans. The Territory is full of second-hand ones; and hence they are employed while they can be purchased for nearly the price of old iron, although their small capacity renders them inferior to the best California patterns. Mr. Bradley, however, finds their use in his mill profitable, reporting that the three he has already save him $15 per day, which would otherwise be lost in the tailings.

To the east and south of the gold belt some important silver m have been discovered, of which the Coaley, below Black Hawk, is of the most noted. From this vein, opened by a tunnel, shallow sh and inclines, a large quantity of ore has been extracted. There very rich streak in one part of the mine, abounding in native sil The property was sold last fall for a large sum—sufficient, I am inforn to extricate the owner from serious embarrassments resulting from vious operations in the business of reducing ores, etc.

PROCESSES, PAST AND PRESENT.

As I have remarked, the full discussion of the treatment of sul retted ores is reserved for a future report. A brief survey of the cesses which have occupied public attention in Colorado, and of th now in use, with general comments upon their nature, history and va will not be inappropriate in the present chapter, and may serve to pare the way for a future and more thorough essay.

Keith's process.—To Mr. Keith belongs the credit of having dev and introduced one of the earliest and best substitutes for the rever atory in roasting ores. According to his plan, the ore, crushed in a crusher and ball pulverizer to fine powder, was blown by means fan into and through a flame, and down an inclined flue beyond, t posit itself in chambers. Originally the crusher and fan were one the same, Howell's centrifugal crusher being employed; but this found impracticable. The inventor claimed that, by this momen contact with the fire, the ore was thoroughly roasted, the fine part of gold melted together to small globules, and the volatile substa expelled. Before the roasted ore was amalgamated, it was crush second time; and owing in all probability to this circumstance, a somewhat improved method of amalgamation, the patentee was ab obtain from docile ores results a little superior to those of the com stamp-mill. Upon really refractory ores, however, he failed to ac plish this. The cardinal defect of this method is the attempt to de phurize in a reducing flame, and in a single second. Samples of roa ore from this process, tested by analysis, showed, besides a very l sulphate of copper and oxide of iron, a large amount of entirely u composed sulphurets.

Crosby and Thompson's process.—In this process a somewhat diffe apparatus was used for roasting. It consisted of a long cylind boiler-iron, which revolved on a hollow shaft, perforated with hole the admission of air. A condensing chamber, connected with the nace, served to catch the fine dust carried off by the draught, and according to the patentee, such gold as had been vaporized by the h The fire was applied on the outside of the cylinder. This process adopted by some thirty companies, and failed in every instance to e a complete desulphurization. It was probably the most ruinous of many experiments tried in the Territory, since so many parties ri so much capital upon it before its value had been sufficiently pro The inventors themselves had great faith in it, and were the la give it up. As late as 1867 one of the partners returned to Colo announcing that he had detected the reason of the previous failure amalgamate the product of the desulphurizer. It was, according to owing to an oxidation of the gold and its escape as a brown pow But he could not persuade the public to try the method by which he posed to remove this imaginary evil. This discovery of the oxid *gold*, by the way, was professedly made, not in the amalgamator, n a very old book. Inventors would probably do better, in studying chemical subjects with which they are not thoroughly acquainted, to take modern instead of ancient literature as a guide.

Dodge's desulphurizer.—This machine was exhibited in New York, and I believe one or two were erected in Colorado. It was also a long cylinder, and the roasting was too quick and too much excluded from the air to be thorough. Mr. Dodge patented, also, a jaw-crusher, which he combined with rollers for finer pulverizing. The machine was alleged to be in its main feature an infringement on Blake's; but it had one interesting feature, which, to me at least, was new. The jaws were lined with soft wrought iron instead of chilled cast iron; and it was claimed that the plates lasted much longer. The combination with rollers was not practical. It is better to keep the two separate, running each machine according to its capacity and the work required of it.

Kent's process.—This process is claimed to effect a perfect roasting. The ore is mixed with brine and formed into bricks, which, after drying, are piled in a kiln and burnt. The capacity of such a kiln was put by the inventor at an incredible figure. The object of using the salt is to produce soluble chlorides of copper and iron, which are to be leached out of the ore after roasting. The process is, therefore, primarily a copper-extraction; and, as such, closely resembles one tried in Germany, and discarded there as impracticable. The reactions may be produced with a single cake or brick in the laboratory; but it is extremely doubtful whether they can be controlled or carried out on a large scale. Theoretically, the imperfect access of air in such a kiln should cause the formation of insoluble dinoxide and dichloride of copper, which could not be leached out, and which would consequently produce a very base amalgam. The large proportion of earthy gangue (quartz, &c.) in the ore is an element not to be overlooked, and calculated to hinder the brick-roasting from having any effect. The repeated handling of the ore, in a region where manual labor is expensive, is another objection. Professor Kent, of New York, who suggested this process, was prevented from carrying it out in person, on a large scale; and the theoretical difficulties, to which I have alluded, were consequently never grappled with by the person who might perhaps have been best prepared to meet them. A believer in the method, however, attempted to employ it at his own expense, and several tests were made at Central City, the results of which are not accurately known to the public. It is reported that the first test yielded from 1,200 to 1,500 pounds of tailings, about two ounces of retort, which, however, when refined, was found to contain 90 per cent. of copper and only 10 per cent. of gold. This result proves nothing except the insufficiency of the oxidation or chlorination, and the consequent production of a base amalgam. It is supposed that the process is abandoned.

Bartola's process.—It is difficult to reconcile the history of this invention with the hypothesis of honesty on the part of the inventor. The secrecy with which its manipulations were conducted, and the readiness with which, after failure in one place, it was revived with the same splendid promises in another, and the immense prices exacted for its use, in advance of all practical success, were not the usual signs of a sincerely proposed improvement in metallurgy. The process consisted in an exposure of the ore in vats to the disintegrating action of various chemical agents, among which, at one time, were steam and pyroligneous acid, from the distillation of green wood, and subsequent treatment by amalgamation in small pans. To the fine washing and careful grinding in the pans is to be ascribed the most of whatever success attended the process in small trials. I believe the vats were afterward discarded. The pans are too small and too slow in operation to be economical. This process, like many others equally insufficient, had in its favor the fact that nothing is easier than to effect a partial desulphurization of pyrites. Steam, acids, heat, even exposure to the weather, in fact anything which produces any chemical change whatever, begins by attacking the sulphuretted combination. It was, therefore, comparatively easy to convince the ignorant that a particular process accomplished great things, the items of cost and relative efficiency being kept out of sight. It may be said of Bartola's method that it was neither metallurgically nor economically successful on a large scale, and its principal legacy to the Territory has been a large amount of wholesome experience and more or less useful second-hand machinery.

Mason's or Hagan's process.—This consists in using for roasting a furnace similar to a lime-kiln, which is charged with 30 tons of ore in lumps, to which a gradually increasing heat is applied, together with superheated steam. The whole charge is roasted in 24 hours, and the ore is then crushed and amalgamated. It is scarcely possible that this process should effect a complete desulphurization, so long as the ore is in lumps. As to the form of the furnace and the use of steam, they are not new, except perhaps in the details of the introduction of the steam. A similar furnace has been employed in the north of Europe for calcining iron ores, containing traces of sulphur, and also for the preparatory roasting of certain silver ores, destined for peculiar subsequent treatment. But it is almost or quite abandoned, even for these purposes; while, for the desulphurization of pyrites, careful experiments, conducted with air alone, with steam alone, and with both together, have led to the general conviction among European metallurgists, that the use of steam does not confer any advantage. Mr. Hagan, who now represents the process, has recently renewed experiments with it in Colorado, and his first reports are very sanguine; but in view of the theoretical and historical objections above given, I prefer to wait for more positive proofs before accepting the claims of the method. I may add that the German kiln for steam-roasting had one advantage which the American inventor should borrow; it was continuous in its operation.

Monnier's process.—This inventor roasts the finely pulverized ore with an addition of 10 per cent. of sulphate of soda, and a little copperas, or similar substances, in a large muffle furnace, eighty feet in length, through which it is gradually worked, from the flue to the fire-bridge. The object is to convert the sulphides of copper and silver into sulphates; and the roast is considered complete, when only a small amount of sulphate of iron remains undecomposed. By leaching the roasted ore, the copper and silver salts are extracted, and then precipitated from their solution by means of metallic iron and copper. The tailings, containing all the gold, are afterward amalgamated in arrastras or pans.

The principal advantages claimed for the process are the saving of fuel by the great length of the furnace; the saving of all the useful metals, including sulphur; and the promotion of oxidation and desulphurization by the use of sulphate of soda, which, at the same time, prevents, to some extent, the formation of insoluble silver salts. As to the saving of fuel, it is true that if comparison with a common, short muffle furnace is intended, this one must be more economical; but, on the other hand, it must be acknowledged that muffle furnaces of every kind consume more fuel than those in which the heat is applied directly to the ore. The alleged saving of all the useful metals is not borne out y facts. Lead and zinc, for instance, are not saved at all, and gold is but nperfectly saved by the subsequent amalgamation. Silver and copper re completely extracted, unless antimony or arsenic is present, in which ise insoluble salts of silver will be formed, which remain in the tailigs, and are consequently lost. For the extraction of copper the process too expensive in Colorado. The sulphur can be saved by manufacuring sulphuric acid, but this could be better done with other furnaces. he principles of this process, so far as the extraction of silver and pper is concerned, are perfectly sound. It is, in fact, the identical ethod introduced in Mansfeld, Prussia, in 1849, by Mr. Ziervogel, for e treatment of the so-called *Kupferschiefer*, or copper-slate. Mr. Monier, I believe, has added the sulphate of soda as a new feature, but this perhaps unnecessary for ores which contain a large amount of sulphides f iron or copper.

Lyon's smelting works.—These works, the first of the kind in Colorado, ere built by James E. Lyon & Co., and their example would have been llowed had not the irrational and defective arrangement of the estabshment, combined with several other circumstances, rendered profitable erations almost impossible. The different parts of the works were ithout convenient connection. The dressing works occupied the lowest vel of all, and were so constructed as to require a disproportionately rge number of workmen, besides involving a considerable loss of marial. One continuous jigger, combined with a shaking-table and a anket-table, the whole requiring only two attendants, would have complished more work with less waste. After concentration the ore as conveyed to four different roasting furnaces, situated far apart, and om these back to the building containing the two smelting furnaces. his passing of the material back and forward could not fail to involve ss of time and labor; but far greater harm was done by the selection the process of smelting with galena and subsequent cupellation. This quired the purchase of galena at high prices, and was attended with rious loss of precious metals in the slag. In the summer of 1866 this ocess was given up, and the method of matte-smelting (under the cirumstances the best) was adopted. Nevertheless, results continued favorable. During eight months of almost uninterrupted running ly from 80 to 100 tons of copper-matte were produced, and at last the orks were closed. Afterward the furnaces were torn down, and more an 100 tons of rich matte, which had leaked through the badly conructed quartz hearths, were found under the supporting masonry. his loss had not been noticed while the works were running. If the lue of this matte be added to that of the official production the works ill, perhaps, be found to have earned a small profit in spite of the disadintages enumerated. Professor Hill's works, a short distance below em, have now been running two years, with moderate profits, owing the careful management of the superintendent himself, and the expeence and prudence of his chief metallurgist.

The Terrace furnace.—This furnace, based on the patents of Gerstenfer, Partz, and Stetefeldt, was introduced into Colorado in the sumer of 1866, by Mr. Lyon, and tested at his works with satisfactory relts. Unfortunately, however, it shared the fate which overtook the hole establishment, and it has thus far never been used elsewhere in e Territory. Evidence as to its value as an apparatus for roasting, eparatory to smelting, is, however, abundant from Germany and Engid, where it is very extensively used. In its usual form it is a shaft nace, 20 feet high, 4 feet by 2½ in the clear, and closed at the top by arch. The pulverized dry ore is charged by means of a grooved roller through a slit in the arch, 2½ feet long, 2½ inches wide, and parallel wi the short side of the furnace. Below, on each short side, are two fi places which serve to heat the furnace at the commencement of the ca paign, and whenever the quantity of sulphur in the ore is insufficient maintain combustion. The feeding apparatus is so arranged that wh the roller stops no ore can enter the furnace, while an increase in the spe of the revolving roller augments the quantity of ore passing through t slit, and thus, by supplying additional sulphur, elevates the temperatu within. The free fall of the ore is hindered by a series of terraces shelves extending from the front to the rear wall, and consisting equilateral triangular prisms of fire clay 5 inches in width, and lying that one of the sides is uppermost and horizontal. The first terrace directly under the feed-slit, and upon it the ore accumulates until reaches its natural talus, differing for different materials and fineness but averaging for sands about 30°. Eight inches lower are placed t terraces in such a position as to receive the ore sliding from the first both sides. Upon these it again accumulates and slides and falls to t third series, consisting of three terraces. Below these are fifteen su cessive series, alternately of six and seven terraces, so that t whole number in the furnace amounts to 103. By virtue of this hi rance to its accelerated fall the ore remains seven or eight seconds motion, and exposed in a finely divided state to the oxidizing influen of the ascending air. The temperature is kept up by the combustion the sulphur in the ore, and therefore depends upon the draught and t rate of feed. Since the whole charge, with the exception of a sm quantity accumulated on each terrace, is constantly in motion, and t quantity in every part of the furnace is the same, nothing distu the uniformity of the process unless it be a casual variation in t contents of the ore. This can be counteracted by local regulation the supply of air, effected by means of a small port hole in the fr of the furnace, over the end of each terrace, which can be opened closed at will. A single workman can easily attend to two furnac the feed being automatic, and the result is much less dependent up his attention than in any other apparatus. After the furnace is o in operation and the proper rate of feed and draught has been det mined by experiment for the particular ore treated, it will run for a lo time without interruption, and if the ore contains sufficient sulph without fuel. The campaigns of the terrace furnaces at Swansea, England, Freiberg, in Saxony, and Mansfeld, in Prussia, usually l eighteen months. The capacity of the furnace is measured rather the quantity of sulphur to be burned than by the quantity of ore charg Since the temperature must not be allowed to rise so high as to sinter melt the ore, it follows that ores rich in sulphur must be fed more slo than those containing less sulphur. In Freiberg, from two to three t of crude and dressed sulphurets are roasted by each furnace in twen four hours, while in Mansfeld, where copper matte, containing far l sulphur, is treated, the daily capacity is six tons.

Whether the terrace furnace (perhaps increased in height) could employed to roast auriferous ores so as to leave the gold in amalga ble condition, is a most interesting question, as yet unsettled. I sincer trust it may be tested for that purpose, since in every other respect great simplicity and the unsurpassable cheapness of the roasting wh it effects, the expense of crushing not being reckoned, render it an mirable apparatus for the treatment of low-grade ores where both f and labor are dear.

Brückner's revolving cylinder.—This apparatus is fully described, es

ally in its application to silver ores, in a subsequent chapter of the
esent report. A few general observations will, however, be appropri-
e here. This furnace, introduced for the roasting of gold ores in the
mmer of 1867, achieved a substantial success, accomplishing all that
us claimed for it except in the important particular of capacity, which
d been rated too high by the inventor, who, on the strength of the
sults obtained from a small test furnace of the capacity of one ton,
pected the larger furnace to treat five tons daily. In actual practice,
o and a half tons were roasted in 24 hours. This economical defect,
ough it did not invalidate the metallurgical principles involved, prob-
ly hindered the adoption of the process for which, moreover, as citizens
Colorado assert, the patentees claimed an excessive royalty. Mr.
ückner himself, however, treated for a long time the most refractory
es from the Bobtail, Briggs, Bates, Gregory, &c., extracting from eighty
ninety per cent. of the assay value. He announced as a fact estab-
hed during these operations, that in roasting these gold ores the sul-
ate of copper must be entirely decomposed in order to obtain satis-
ctory results by subsequent amalgamation.

Besides the small capacity of the Brückner cylinder, however, there
a metallurgical objection to this process as applied to first-class ores,
mely, the loss of silver and copper. A small portion of the silver,
loyed with gold, is saved, and, in fact, the whole of it could be by a
loridizing roasting, which is the form of this process applied to silver
es proper. But very few of the Colorado gold ores contain enough
lver to justify the additional expense of such treatment; hence the loss
the silver combined in the ore as sulphuret is for the present unavoid-
le. The copper could, of course, be saved by converting the chalco-
rite into sulpuret of copper and leaching it out, but the process would
come so complicated and expensive that the value of the copper would
t cover the additional cost. The value of silver and copper in the first-
ass ores usually ranges from $30 to $40, coin, per ton. No process
hich cannot profitably extract these metals should be employed on
at kind of ore, however suitable it may be for those which contain
t inconsiderable amounts of silver and copper. The second-class ores
Colorado belong to the latter category, and for these the Brückner
linder would be the best process hitherto introduced, if only the cost
treatment by it could be reduced to $15 or $16 per ton. This does not
em to me impossible. Mr. Brückner's price for custom-work was $30.
stimating this as $5 above cost, we have $25 per ton as the actual ex-
nse. His works were on a very small scale. Twice the number of
rnaces and amalgamators could be managed by the same number of
en as he employed. By doubling the capacity of the works the only
pense increased would be that of fuel and quicksilver, and the cost
r ton would be reduced at least $5. To increase still further the ca-
city of the cylinders and thus diminish the running expense, Mr. Wol-
rs suggests the propriety of combining these cylinders with the terrace
rnace. A preparatory roasting in the latter would remove about
fty per cent. of the sulphur at a cost not exceeding $2 per ton, includ-
g a royalty of fifty cents per ton. Of the ore thus prepared four
ns can easily be treated daily in one cylinder. The capacity of works
ntaining four cylinders would thus become 16 tons instead of 10 tons,
d the cost of the cylinder roasting will be reduced to five-eighths of
0, or $12 50 per ton. Adding to this the additional expense of
e terrace roasting, conveying the ore to the cylinder, wear and
ar of the latter, &c., which could not exceed $3 per ton, we have
5 50 as the cost of treating one ton of ore by the combined process.

This may be compared with the stamp-mill treatment on the aver milling ores as follows: The common yield obtained from one cor average ore, about seven tons, is six ounces of gold, worth from $12 $130 in currency, say $125.* According to the highest estimates, t is half the assay value of the ore. Deducting $25 for mill fees, we h a net yield of $100 from seven tons of ore, worth $250. Working t quantity by the combined process indicated, we should obtain eigh five per cent., or $212 50, at a cost of $15 50 per ton, or $108 50, leavi $104 as the net yield. The difference in profit is not very great, but production is largely increased, and many more persons are furnis with employment. If $2,500,000 gold bullion are produced, for insta in one year from the stamp-mills, the actual value of the ores worke probably $5,000,000, and the same quantity of ore might have produ $4,250,000, at an additional gain to the proprietors of only $80,000, to the public of $1,750,000. There can be no doubt that such an crease of the bullion production would greatly improve the prospe of the whole country.

According to this suggestion, the auriferous copper and iron pyr should be separated into three classes, the first containing all the cop pyrites, to be sold to the smelting works; the second, consisting of i pyrites with some gangue, to be treated by the combined terrace nace and Brückner cylinder; the third, consisting of gangue or w rock with more or less iron pyrites, to be sold to custom stamp-m whenever it is worth enough.

A consolidation of interests, both in mining and smelting, seems to the most necessary step in the direction of economical and profita working. One of the best lodes in the country, for instance, is cu with a dozen companies, each requiring its own agent, its two shafts separate pumping and hoisting apparatus, its stamp-mill, &c., tho one agent, a tunnel and two shafts would have sufficed for all the wo thus far, and for some time to come. This most important reform m be the work of time. The principal difficulties lie in the inflated no nal capital and enormous past expenditures of the companies, the de of each to get the best bargain in such a consolidation, and possibly, inclination of employes to hinder an arrangement which might th them out of place. The policy of consolidating metallurgical operatio other than those of stamps and pans, is equally wise and necessa The success of Professor Hill's smelting works, and of the reduct works of Steward and of Huepeden & Co., at Georgetown, are illust tions.

Professor Hill's works.—These works are located half a mile bel Black Hawk, on Clear Creek, and have been in operation about t years. They are owned by an eastern company and superintended Professor N. P. Hill, formerly of Brown University, to whose excell business management their success is largely due. Professor Hill e ploys a skillful German metallurgist to manage the technical operatio The works consist of two reverberatories for roasting and two for sme ing, together with roast-heaps in the open air. There is also a terr furnace, which has never been used. The process employed is preli nary roasting in heaps and in furnaces, and subsequent smelting matte, which is then shipped to Swansea, England, for further tr ment. The copper in the matte pays the cost of transportation and fi extraction. The roasting furnaces have three hearths each, arranged

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* This calculation is made with gold at 130 to 135. A fall in the price of gol creases the currency values but not necessarily the mill fees, wages, &c., at least immediately.

stair-form, and holding separate charges. The two roast seven to eight
tons in 24 hours. The common reverberatories for smelting receive each
charge of two tons roasted ore, partly from the roast-heaps and partly
rom the reverberatories, every eight or ten hours. The resulting matte
ontains forty per cent. of copper. The lump ore is roasted in heaps for
ix or eight weeks, and then crushed with rollers, and mixed with the
res roasted in the reverberatories. The latter are mainly tailings, and
re of course in finely pulverized form when purchased. For ores are
o mixed for smelting as to flux themselves; this being necessary on
ccount of the lack of lime or other fluxes in the neighborhood. The
heory of the process is that a portion of the sulphur being removed by
e preliminary roasting, sufficient remains to form a matte, while the
ide of iron and earthy material constitute a slag. The poorer tail-
gs, which are purchased by the works, do not pay for treatment; but
y are necessary to mix with the others. The following was the scale
prices last autumn. I am informed that special bargains are some-
es made more favorable to the miners; and it is my impression that
s scale has been advanced as a whole within the last few months; but
ve no definite reports on the subject, and can only say that Professor
would probably be willing at any time to give more for rich ores, if
ould be assured of a steady supply, insuring the uninterrupted ope-
on of his furnaces. But this has been hitherto impossible. None
ne mines are in such a condition of steady productiveness as to make
d contracts for the delivery of first-class ore. Indeed, the ore thus
sold to these works does not constitute more than one per cent. of
amount worked in stamp-mills. The scale is as follows:

r ore containing per ton—	Is paid, of the value—
2 ounces gold	20 per cent.
3 ounces gold	30 per cent.
4 ounces gold	40 per cent.
5 ounces gold	45 per cent.
6 ounces gold	50 per cent.

or silver, seventy-five cents per ounce is paid, after deducting as many
es of silver as there are per cent. of copper in the ore. For copper
or each per cent., deducting one-half per cent. from the amount indi-
d by wet assay. No account is taken of quantities less than one
e of silver, one per cent. of copper, or one-quarter ounce of gold.
above rates are in coin.

is understood that Professor Hill will before long enlarge his works,
s to treat his mattes upon the spot. This can probably be done with
it by using chamber acid, manufactured from the sulphurous fumes
ne roasting process, and by shipping the copper to market. Possibly
terrace furnace may play an important part in this modification of
present system.

he stamp-mills.—The general subject of stamp-mills is discussed in
ther part of this report. A few particulars will be here given as to
type of mills usual in Colorado. These are simple in construction,
generally well built, so far as solidity and convenience of construc-
are concerned, but not always calculated in proportions to corre-
nd with the requirements of the process employed and the particular
treated. Iron stems, collars, heads and shoes, are universally em-
yed. The weight of the stamp varies from 400 to 800 pounds, a pre-
nce being shown for the heavier weights; or rather, these being at
sent the most common.* The usual fall is 10 to 14 inches, and

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Engineers traveling in Colorado have too often confounded the use of a particular
aratus or pattern with a preference for it. The fact is, there are few mills in Colo-

the average number of blows 25 to 30 per minute. Many batt however, are run as slow as 19 per minute, and some at 15. secret of this extraordinarily low speed is probably a desire to cat much gold as possible in the battery, and to avoid swift currents o copper plates. Yet, these objects could be better attained by m which would not so directly interfere with the efficiency of the st batteries. The stamps play in cast-iron mortars upon movable There is a sort of superstition among American mill men in favor of loose dies, instead of the solid single die-plate of the Germans, whic be turned when worn, and even when worn out, is worth, in propo to its weight, just as much as at first. The mortar-boxes contain gamated copper plates before and behind the stamps. The screen of punched copper or Russia iron, or of wire. Before the batteri the tables carrying the copper plates and blankets. These are gene inclined about 12°; but they are not adjustable. Increasing the and diminishing the inclination of these tables would permit the sw running of the stamps, and obviate many objections urged against plan. At present rates of speed, a battery of five stamps will crush half a ton of pyritic ore, or three-quarters of a ton of surface quart stamp, in 24 hours.

The tables* are lined with amalgamated copper plates, which ar pared generally by washing the copper plates (after they are fast on the table) with a strong solution of cyanide of potassium until a b surface is obtained, and then rubbing on mercury, the tables then covered with a mixture of lime and sal-ammoniac until used. The ration of rubbing on mercury is repeated several times. On first ning over ore, a large amount of the gold is taken up and remains p nently on the plates, gold amalgam readily settling fast on solid b Below the copper plates are laid the blankets for catching the ama which is carried over the tables. The mass which passes the bla is either lost, or collected in tanks and buddled or washed in a r primitive manner.

About two-thirds of the gold obtained is found on the copper p which are inside the mortars. The amalgam is obtained by scra the plates with rubber scrapers, after which more mercury is throw the plates. The tables are cleared once in 12 or once in 24 hours. blankets are washed in tanks usually about every half hour. The bla tailings thus obtained are generally amalgamated in pans, the Ba being the favorite.

It is impossible to state accurately what percentage of the gold is in milling, as few assays are made either of the crude ore or of the ings; but that a very large amount is lost cannot be doubted, and loss probably varies from 30 to 70 per cent., according to the natu the ore. None of the silver is saved, except a small quantity, wh being obtained in the gold, merely diminishes the value of the la metal.

There are some variations from the above in some of the mills. instance, in one case the ore from the battery is passed over a shal

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rado (or anywhere else) which would not be altered in some particulars if their prietors had them to build over again. They wisely make the best of whatever chinery chance, or former owners, or tempting auctions have endowed them with. young student, in making notes of such establishments, would do well, frankly t the superintendents this question: "What would you change, if you had this again?" The answer, if honestly and intelligently given, would contain the best that experience can bestow upon science.

* This description is partly taken from the columns of the Engineering and M Journal, in the letters of the correspondent before mentioned.

e of the Keith pattern, *i. e.*, with a bottom of corrugated plates. The
s from the tables passes into Cornish buddles for concentration, and
ien amalgamated in Bartola pans. This method, however, does not
ı to work particularly well, and mill men generally seem inclined to
: to the stamps and stationary tables. Attempts to work over the
igs from the mills are now beginning to be made, and thus undoubt-
much precious metal will be saved, some of the tailings being quite

Among other experiments at the Black Hawk mill, the Rittinger
ssion table is being tried. In this case much doubt as to the suc-
f the table had been expressed by spectators, but the machine,
I saw it, had not had a fair trial, the experimenter not having the
o give the requisite amount of attention. The table has been a
d success in Europe for certain classes of ores.

article published lately in the Central City Register defends the
mills against the charges of experts from California and the East.
riter says:

> we recognize a certain value in every improvement, and intend always to give
> t hand of fellowship to every process introduced in which there is a probability
> ss, we hold to continuing our present modes for general use until demonstration
> wn country and upon our own ores proves that a different mode will make
> t money. That many of our older mills are inefficient and need rebuilding is
> doubt, but as this process is constantly going on, and as the new mills being
> are, almost without exception, put up in a good, substantial manner by persons
> bly versed in the milling of our ores, we hope there will be no further changes
> shion than such as are suggested by practical experience upon our own ground.
> a hear how milling is done in California and Nevada, as if their modes must
> ily produce the same results here. First and last, we have had a host of Pa-
> ıst men here to instruct us; and formerly each coming man was hailed as
> Moses to lead us out of the wilderness. The mode of pan-amalgamation, as
> d by Mr. Hitchens, is highly spoken of by gentlemen from Clear Creek County,
> trust that his success will at least partially compensate for the useless ex-
> 'es heretofore. Others of our citizens, not practical mill men, have argued
> s that we should increase the speed of our stamps to 60 or 70 drops per
> because they have done so in California. In offering this advice they have
> two things: first. that our ores and the condition of the gold in them were
> lly similar to those of California; and secondly, that all of our own ores are
> their composition and in the condition of the gold in them. Both of these
> ions are untrue. All the evidence goes to show that, as a rule, the ores of
>) contain more sulphurets than those of California, and that the gold in the
> s more finely subdivided than in the latter. Whoever leaves these facts out of
> tion argues from false premises. From the universal experience of mill men,
> e confidently asserted that no given number of drops per minute can or ought
> ɔpted for all of our ores. Every experienced mill man knows that with soft,
> ›sed ore, whether surface or otherwise, and where the gold is very fine and the
> or soft, a slow rate of motion is necessary to do the best work. It is equally
> lerstood that a fast motion is necessary for the best work where the ore is hard
> gold is coarse. Experiments at the Kip & Buell mill, on Bobtail ore, showed
> the number of drops per minute was increased from 30 to 60 there was a
> improvement in the yield per cord, as well as an increase of the amount
> while another mill running upon the same ore diminished its yield while
> at a slower rate each successive week. On the other hand, the ore from
> ; claims on the California yields an ounce per cord more under the heavy
> of the Black Hawk Company's mill, running 16 drops per minute, than it
> ler the lighter ones, running 32 drops per minute. Running at 60 or 70
> ıute, it is doubtful if it would pay for crushing. The first experiment
> that Bobtail ore should be run on high motion, and the other example that
> s California does better on slow motion. Simply this and nothing more, unless
> ence that there is a wide difference in the ore or in the condition of the gold
> ›re from two deep mines, and that a corresponding difference is necessary in
> de of treatment. Is anybody who attempts to instruct the community so
> t as to demand that a mill running on soft surface ore or dirt should run 60
> rops a minute? Every man of any experience knows that such a motion on
> : would convert a battery into a steam churn. He would do better to sluice
> at once. We do not wish to be understood as opposing high motion when it
> employed without diminishing the yield, but we are confident that the greatest

obstacle to a general increase of speed lies in the fineness of the gold in our or
recognizing this, the men who furnish the ore to our custom mills demand a slo
of motion. It has been attempted of late to make a point against our mills
ground of leaky batteries. On this point we have the testimony of a machinist
business it is to repair and build mills. It is his opinion that not one battery
leaks at all. But supposing that half of them do, which supposition must sati
most greedy grumbler, the loss of gold by this means is ordinarily but a trifle a
pared with the whole loss. This is universal experience, as has been proved se
times, by providing a receptacle for the leakage and afterward carefully pan
down. Of course there are some exceptions, as has been proved by large "clea
around old mills. But the leakiest mill we ever saw was one of six stamps th
saved $60,000 in gold. It required about the amount of a pair of blankets to c
around the housing, and yet after its removal an expert in the business was ca
know what he would give for the clean-up around the battery sill, and after
day's examination he said that $100 might be got out, but it would cost $150 to
So much for the catchword of leaky batteries. They are growing less and les
month, and that by simply doing the work better without adding to the heig
expense of the mortars. One going into the Black Hawk mill and seeing the wa
the floor next to the batteries might think they leaked, but if he will take the t
to examine the five mortars that have just been removed to give place to other
lighter stamps he will see that those five have not leaked a drop. A leak betwe
batteries and the tables is much more common than around the housing, but
rare instances—none that we know of at this time—amounts to anything wort
tioning. Our opinion is that a thousand times as much gold is lost by irregula
ing as by leakage. Whoever will invent a cheap adjustable self-feeder will be
efactor. It is a libel on our country to assert that we are "following a
blindly." We are simply holding fast to the methods that are the best for
adding such improvements as are tried and found valuable. During the past
large number of new mills have been put up, not by stupid, inexperienced me
by those who have been taught both by failure and success, and men who kno
to squeeze as many net dollars out of a load of rock as their would-be instr
Many improvements have been adopted, among which are the planing of the n
wherever a joint is to be made with wood, the introduction of adjustable guides, a
adoption of the double-faced collar. New methods of concentrating tailings hav
adopted, and, if found successful, will be generally used. We see no disp
among our mill men to be self-opinionated or old-fogyish. Experience has t
them to hasten very slowly in taking the advice of those whose experience ha
in another field, and they are right. It is not a radical change in our modes
chinery that is wanting for our increased and permanent prosperity so much
careful and economical use of what we already have, and a more general adop
improvements that have been tried here.

There is one other direction in which we may perhaps look for n
inventions to render the treatment of auriferous pyritic ores of me
grade both cheaper and more effective. I refer to the new develop
of pan amalgamation with the judicious and adequate use of chemi
The practice hitherto has generally been to add chemicals in such
portions as to have no real chemical action on the whole mass of
The Empire mill in Grass Valley, California, now employs a pan
cess for sulphurets, which is asserted to be far cheaper than chlo
tion, and almost equally effective. The capabilities of the pan ama
mation are certainly not yet fully appreciated; and the experienc
the Janin Brothers with the sulphuret of silver slimes at Virginia
Nevada, together with these reports from California, lead me to an
pate some decided advance in that direction. In the increasing scar
of fuel, it must be borne in mind that all mechanical processes w
can be carried on by water, or even wind-power, have a special clai
consideration. As the treatment of sulphurets in Colorado has alw
been an economical rather than a metallurgical problem, I will add
small pans, in my opinion, though they may answer all theoretical
quirements, will take too much power and do too little work to solve
practical question successfully.

The latest advices I have received from Gilpin County give the n
ber of mills and stamps running at the end of November 1869, as sh

following table. It was then confidently expected that all these ould continue operations during the winter:

Mills.	Number of stamps.	Cords of ore crushed per week.	Mills.	Number of stamps.	Cords of ore crushed per week.
o	30	15	University	15	10
awley	15	9½	Mead's	20	14
	12	7½	Holbrook	13	9½
	12	7	Fullerton's	15	10
	12	8½	Star	24	14
	12	7½	Tomlinson	12	7½
bbey	25	12	Geatty	8	5
	23	18	Sterling	15	12
	55	40	Smith & Parmelee	25	18
l Gregory	50	40	Briggs	25	36
	80	35	Cheney's	12	6
s	10	8	Brastow's	20	14
	20	12	Illinois	22	12
	20	13	Leavenworth	12	6
ntain Gold Company	20	14			

tals of these figures are: Mills, 29; stamps, 624; cords of ore per week, 421. Estimating seven tons to a cord, we have 2,947 ore crushed per week. It must be noted, however, that a few not embraced within this list; the number being six, if I am informed. This would make the whole number of mills running thirty-five, while the number of stamps and the amount of ore per week would also be somewhat increased. Probably 700 and 3,250 tons of ore per week would be a fair statement of what done. This is the winter basis, and does not include the mills in during the summer, and are now shut down for the winter. da City alone this amounts to 60 stamps.

verage amount of ore crushed per week to the stamp is $4\frac{9}{14}$ tons, f a ton per day to the stamp. The heaviest stamps in use 50 pounds, drop 15 times per minute, and crush an average tamp of $3\frac{1}{16}$ tons per week. The lightest stamps used weigh nds, drop 30 times per minute, and crush an average to the f $4\frac{3}{8}$ tons per week. Stamps weighing 450 pounds, dropping s per minute, crush $4\frac{2}{3}$ tons to the stamp per week; dropping s per minute, crush $4\frac{23}{24}$ tons to the stamp per week. The speed of stamps weighing 500 pounds is 40 drops per minute, the amount of ore crushed is $4\frac{9}{10}$ tons to the stamp per week. est speed of 500-pound stamps is 24 drops per minute, and ount of ore crushed is $4\frac{1}{5}$ tons to the stamp per week. The speed of eight mills running 500-pound stamps is 31 drops ute; the highest speed of 550-pound stamps is 40 drops per crushing an average of $10\frac{2}{25}$ tons to the stamp per week. est speed of 550-pound stamps is 30 drops per minute, crushne mill $5\frac{1}{4}$ tons per week to the stamp, and in another $5\frac{1}{11}$ tons k to the stamp. It will be noticed that the heaviest stamps, at the lowest rate of speed of 15 drops per minute, crush tons to the stamp per week, while the average stamps, weighpounds, and dropping 40 times per minute, crush $10\frac{2}{25}$ tons tamp per week. This gives a difference in favor of the lighter and faster drop of $7\frac{7}{400}$ tons per week to the stamp.

g the large companies working are the Smith & Parmelee, Black Hawk, and Consolidated Gregory. The Ophir, Grinnel, Mountain, Sensenderfer, Narragansett, and a number of companies on the Bobtail are shut down, Among the really successful mines are the California and U. P. R., which are, and have been, yielding their owners large profits. As they are private and personal enterprises it is exceedingly difficult to get any figures for publication. The celebrated Coaley lode is probably not surpassed in Colorado as a paying silver mine. Its total yield this season has been about $66,000. Of this amount $16,000 were realized from forty tons of ore, at an average of $400 per ton.

The average price for crushing ore is $30 per cord. The supply of ore during the past summer has been about equal to the demands of the mills, and is probably now in excess. The shutting down of so many of the Nevada mills necessitates the hauling of a good deal of ore from lodes in that vicinity tq Black Hawk for crushing. This is attended with an expense which cuts down the profits to a very small percentage. The late operations at the Briggs mill ought to be mentioned here, as they throw much light on the relative merits of heavy stamps with slow motion and light ones run at high speed. They had been taking out their old stamps and are putting in new ones. Twenty-five were in operation, and twenty-five more were expected to run in a few weeks. The mill formerly contained 50 stamps, weighing 650 pounds, and dropping 22 times per minute. With this mill they crushed 36 cords, or 252 tons, per week. The 25 new stamps, weighing 350 pounds each and dropping 40 times per minute, arè doing the same work as by the old 50, and with all the 50 new ones in operation the capacity of the mill will doubtless be doubled.

CHAPTER LIII.

CLEAR CREEK COUNTY AND THE SILVER MINES.

The first mines in this county were discovered as early as 1859, and both gulch and lode mining were quite brisk at Idaho City, Mill City, and Empire. All the lodes found during that time were gold-bearing, and some of the Idaho and Empire gold lodes are worked at present to good advantage. Near Georgetown several lodes were discovered at the same time; and though every one has since turned out to be a silver-bearing vein, all were first worked for gold. A small stamp mill was erected in 1863: and, according to trustworthy statements, sluicing on the Griffith lode paid well. In sinking down on these lodes, the amount of gold in the ore rapidly decreased, and at present there is hardly a trace of it left. Quite recently a lode has been found between Empire and Mill City, near the forks of Clear Creek, the surface ore of which contains five ounces of gold besides about $200 in silver per ton. Strangely enough, the ore from this lode shows very little copper or iron pyrites, while, as far as my knowledge goes, all the other lodes carried a good deal of one or the other, or both, of these minerals. Nearly all the lodes discovered around Georgetown (called at that time Elizabethtown) during the first two or three years were bought up by eastern capitalists; several stock companies were formed, but, like too many of their predecessors in Colorado mines, they did not accomplish anything. In this, as in the other counties, large sums were paid for undeveloped property; many tons of worthless machinery were sent out; large mill-buildings were erected before the mines were able to supply them; and the whole was managed by agents, generally incompent and without experience in the business. Only one of these companies at present in a healthy and thriving condition. This one confined erations exclusively to the development of what was thought to be its st property. Not having wasted money foolishly, it had the means erect, of late, large dressing works, managed by a competent supertendent, and its operations are now in a promising condition.

The first prospecting for silver ore was done in 1864 by Messrs. Steele, uff, and Layton, from Empire, and the discovery of the Belmont lode, McClellan Mountain, was the immediate result. Several assays made the surface rock yielded several hundred dollars per ton; and 2.75 ns worked by Garrott, Martine & Co., in the fall of 1867, yielded $619 34 coin. At present the company is putting up one of William Brück-r's cylinders; a poor streak, however, has been met with in the mine.

During the next two years there was a perfect rush to the silver mines m all the other counties, and a large number of good lodes were disvered on nearly every hill around Georgetown. Several smelting conrns were erected during that time, none of which, however, were able beneficiate the ore to advantage. In 1867, the active development of me of the prominent lodes was commenced, and work has been carried since that time, at the Equator, Terrible, Baker, Brown, Coin, Clift, riffith, and some others of less importance. The work being, however, most exclusively confined to sinking shafts and driving tunnels, the ole amount of ore mined, up to April 1, 1869, does not exceed 1,100 ns, which, at the lowest estimate, yielded $250,000 in coin. At prest some of the lodes are in tolerably good shape for working, and very ely the amount of ore mined this year will be four or five times as rge as the whole production heretofore. As to the constant call of the wspapers for more and larger reduction works, I must, however, mark, that there is no present reason for such a demand. According my judgment it is an utter impossibility for the mines to keep even ose works in full supply which are finished, or will be so in a very ort time. Until June, 1869, every one of the three small mills at eorgetown lay idle frequently, and during the finest part of the season r. Stewart was afraid of being forced to stop for lack of ore.

Leaving the large dressing-works of the Wilson & Cass Co., which aim a capacity of 60 tons per diem, entirely out of consideration, the llowing amount of ore is needed to keep all the reduction works in pply:

getown Silver Smelting Company's works	3 tons per day.
Huepeden & Co.'s amalgamating works	8 tons per day.
wart's amalgamating and smelting works	8 tons per day.
n Silver Mining Company's smelting works	5 tons per day.
er Silver Mining Company's amalgamating works	12 tons per day.
Silver Mining Company's amalgamating works	4 tons per day.

This gives a total of 40 tons per day, or counting 300 working days, 000 tons a year. However strong the people's faith may be in the ductiveness of the silver mines, there is not at present the least poslity of supplying half that amount. In fact, my boldest expectas will be surpassed if 5,000 tons of good ore are furnished by the es. Whoever has seen extensive and well-developed lodes and is uainted with the production of such, must know that only a limited mber of workmen can be profitably employed in a lode, the developnt of which has been accomplished only to a certain degree. In order steadily increase the ore production of a mine, it is not enough to t a couple of new stopes; the main object must always be to keep ning the ground ahead, so that there shall be always ore enough in

sight to maintain a steady and continuous production. The qu
ore extracted from a mine reasonably ought to be in direct prop
the quantity of ore in the reserves; and as there are at this t
half a dozen lodes in and about Georgetown which might be cal
partially developed, it is utterly absurd to expect 12,000 tons t
tracted the ensuing year, without endangering the continuous
of ores for the following years.

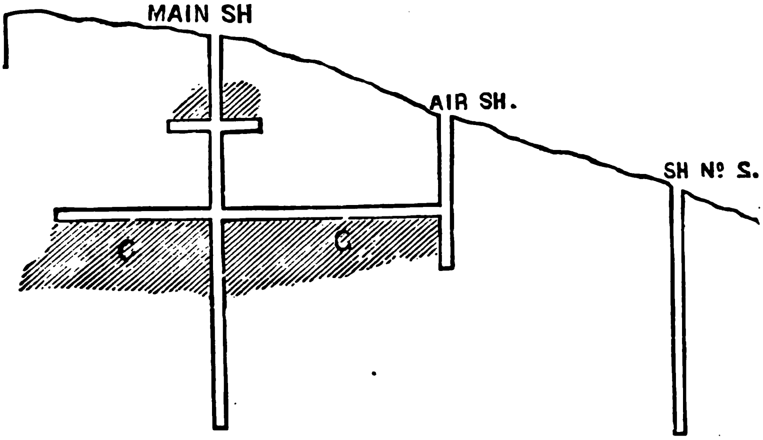
Near the surface, almost all the Colorado silver lodes are mor
decomposed; atmospheric influences, combined with the action o
face water, having gradually converted the sulphurets of lead, i
copper into oxides, sulphates, and carbonates. These being w
partly washed away, have left the quartz porous and more or
ored by oxide of iron or carbonate of copper. When opened
depth, the lodes become galena-bearing, carrying at the sam
larger or smaller amount of zinc blende. Both the galena
blende appear to increase with depth. They decidedly predom
most of the deepest mines. The zinc blende, especially the dar
variety, is often very rich in silver. In the Brown, Coin, and
it always forms a prominent part of those streaks in which r
brittle silver occur most abundantly. Several pieces from oth
on Brown and McClellan Mountains, in which, even with a str
nifying glass, not a particle of silver ore could be discovered,
nevertheless, by assay, from one-half to three and one-half per
silver. Being generally so rich, of course, it must not be separa
the galena, and thus it forms in almost every good lode an ad
the lead ore, quite disagreeable, as far as reduction is concern
presence is especially obnoxious during roasting. According
ner, the zinc blende may, during the operation, cause a loss
which may amount to 60 per cent., and in most cases is at leas
to 15 per cent. The ores produced by the mines at present
divided into two classes, surface and galena ores. This distin
course, is not and cannot be expected to be an exact one; it i
sible to draw a strict line between the two classes, as there i
deal of ore which might be equally well ranked with either.

The surface ores generally contain, besides more or less zinc
a little decomposed galena and sulphuret of silver; and ve
the zinc-blende is also decomposed. With increasing depth the
of galena and zinc-blende gradually increases also, until at a d
exceeding one hundred feet they decidedly predominate. I
instances the decomposition reaches even further down; whil
other hand, many lodes on Brown, Sherman, and McClellan M
showed a strong vein of solid galena and zinc blende, or zin
alone, at the very surface. Wherever the latter was the case, t
blende was worth $200 per ton and upward.

The amount of silver in the ores varies, of course, considerabl
consisting chiefly of fine-grained galena and black zinc-blend
usually very rich, while pure, coarse-grained galena nearly alway
to contain but little silver. The average value of 633 tons of
mating ores, worked by Garrott, Martine & Co., and Huepeden,
& Co., was $126 48 coin per ton; the smelting ores from the
Brown, Coin, and Equator will, however, very likely yield abo
coin per ton.

In order to show how far the development in the best lo
advanced, I give a few sketches of the most prominent ones.
of course, selected those on which the most work has been do
it is but right to say here, that besides these lodes, there are

imes as many more, which look quite as promising as did any of eins described, at the same stage of development. There are, in several hundred out-crops around Georgetown, which, so far as have been opened, seem to belong to excellent lodes.

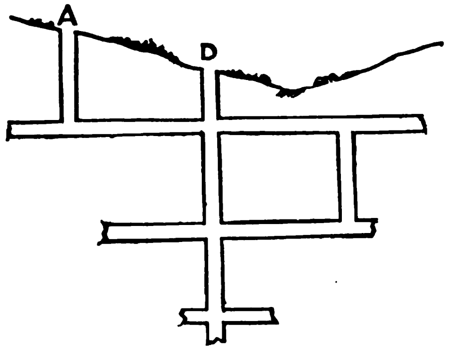


THE EQUATOR LODE.—Scale 100 feet to the inch.

allow shaft is the discovery, east of which the lode strikes north 49° east, while west of the the strike is south 54° 30′ west. Depth of main shaft, 206 feet; of the main level, 100 feet; between main shaft and air shaft, 115 feet. Depth of No. 2, 120 feet. G, G, are under-hand the bottom of the main level. The level is drawn in its original position. West of the dis-30 feet, there is a shaft called No. 1 west, and 50 feet deep, and east of shaft No. 2 there is haft at a distance of about 115 feet, and 50 feet deep. Both from this and from shaft No. 2 short levels running westward, each 25 or 30 feet long. The level from No. 2 is 60 feet, and e easternmost shaft 30 feet below the surface.

his lode, as well as in all the other ones, stoping has but just commenced; and the quantity of ore taken out was almost ex-ly obtained by sinking and drilling. The Equator lode produced August 20, 1869, 300 tons of ore, yielding about $92,000 in cy.

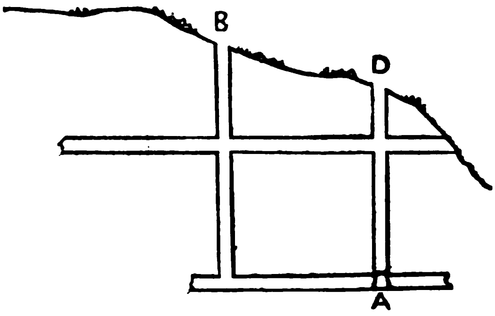
hoisting is done by steam at the main shaft.



THE TERRIBLE LODE.—Scale 200 feet to the inch.

of the lode, north 62° east. Dip vertical to a depth of 80 feet, thence to present depth 15° , air-shaft, 78 feet; D, discovery-shaft, 50 feet. A 28 feet higher than D.

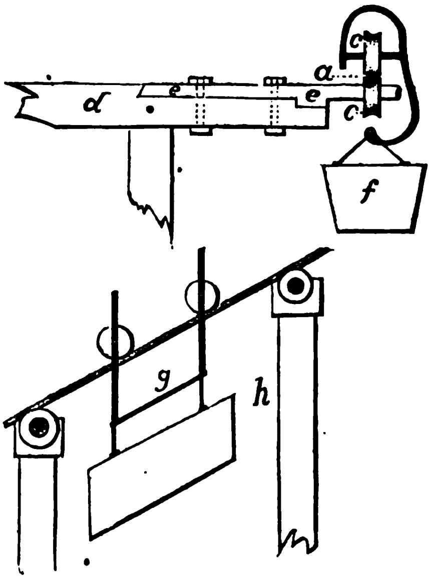
mine has produced 175 tons of ore, yielding $85,000 coin, or at e of $485 71 per ton. A large amount of second and third-class ore is on hand, worth, respectively, $200 and $70 per ton. A tun now being driven, intended to strike the lode at a depth of 235 f the discovery shaft; the point of intersection is 350 feet from the of the tunnel; 120 feet have been completed by the use of the Bu rock drill.



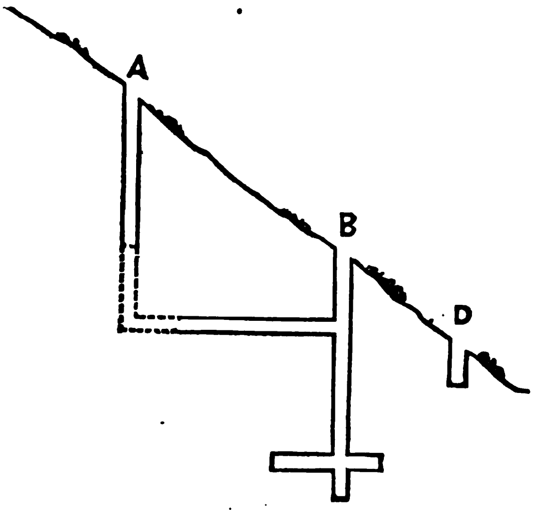
THE BROWN LODE.—Scale 200 feet to the inch.

Course of the lode from discovery west, south 81° 45′ west; course of the lode from disco north 81° 45′ east. D, discovery shaft, 170 feet deep. A, tunnel which intersects the lod angles. B is intended for an air shaft, but is not, in fact, broken through to the surface yet. 35 feet.

The lode has produced 275 tons of ore, yielding $72,000 coin, o rate of $261 82 per ton. Much second-class ore is on hand. Th is worked from the tunnel A, through which the ore is taken o conveyed from the adit-mouth to the foot of the mountain by m cars, traveling upon a suspension wire cable, as shown below.



Suspension tramway.—This ingenious arrangement is highly recommended where the construction of a road-bed might be too sive. This tramway of wire rope conveys the ores from the shaft wn a steep incline to the mill. Its construction appears from the anying diagram, in which *a* is a stationary wire rope, one and rth inch in diameter, fastened to heavy frame-work, well ed at each end; *c*, *c*, two small rollers, one fastened to the end of ss-beam *d*, for supporting the rope, and the other running on the he rope, as a wheel for the car, which is suspended from two of n the manner shown in the diagram; *e*, heavy wrought iron, to *d*, and terminating in the axle of *c*; *f*, the car; *g*, a piece of e to hold the rollers apart. At *h*, a small wire rope, not shown lrawing, pulls the car up and lets it down. There are two lines onary ropes, each constituting a track. The tightening of the es is effected by means of heavy rollers at the lower end of the y, around which they are wound, and which are turned with ikes. The full car coming down on one track pulls the empty on the other. Contrary to the expectations of many engineers, orked so far very well. The annoyance caused by water gatherhe wire cables and freezing there in the winter has not, I am d, proved serious; and, on the whole, the system must be cona success.



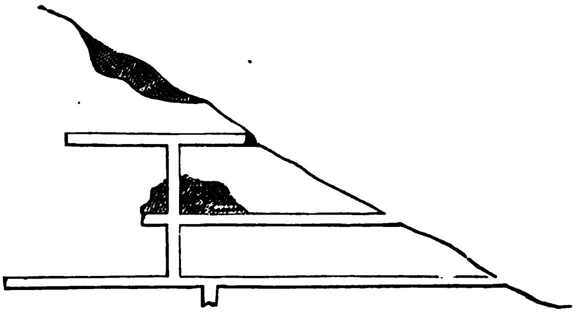
The Griffith Lode.—Scale 200 feet to the inch.

ft; B, main-shaft; D, discovery shaft. Course of the lode, northeast and southwest.

n tons of surface ore yielded $1,152 93 coin. The main shaft, sunk, has demonstrated the existence of an extensive body of n average width of twenty inches. At least 350 tons of firsthave been obtained by sinking that shaft. Three hundred feet owned by the What Cheer Mining Company; 300 feet east, by on & Cass Gold Mining Company.

roduct of ore of the Baker mine has been nearly 300 tons; about mostly surface ore, have been worked by amalgamation, and 4 smelting, yielding together $5,500 in coin. Above 200 tons of are on hand, which very likely will yield from $120 to $130

e is conveyed from the lower tunnel, about 700 feet down the a elevated tramway. For what reason the second tunnel has been driven and the lowest shaft sunk in the place indicated, I am unable to say.



The Baker Mine.—Scale 60 feet to the inch.

Course very near northeast and southwest. Dip about 40° north. The discovery is at the mouth of the upper tunnel. There is some ground worked out on the surface above it; B is the ground stoped out.

The Clift Lode courses northeast and southwest, and has been developed by a discovery shaft 105 feet deep and a drift tunnel 175 feet long, cutting the shaft 115 feet from the tunnel mouth at a depth of 40 feet. Product of ore, 70 tons, yielding $8,500 in currency, or $121 43 per ton.

The Astor Lode courses very nearly east and west. The discovery shaft is 130 feet deep; 1,200 feet east of discovery shaft there is another shaft furnishing the same kind of ore. Surface ground worked out to a depth of about six feet for a distance of 150 feet, has produced 45 tons of ore, yielding $7,500, = $166 67, coin, per ton.

PROCESSES OF TREATMENT.

The varying character of the ores necessarily involves the application of different processes in order to beneficiate each kind to the best advantage. All those ores containing much galena must be treated by smelting; those containing little galena with more or less zinc-blende, and the so-called surface ores, will be worked most economically by barrel amalgamation; and the poor sulphuret ores will afford abundant material for raw amalgamation in Hepburn's or Wheeler's pans. I shall call these different kinds of ore, in the order above given, first, second, and third-class ores. There is but very little of the first-class mined, as only a few lodes produce ore with more than 20 per cent. of galena, the rest being zinc blende, gangue, and usually a little iron pyrites; more than 50 per cent. of all the ore reduced belongs to the second, and perhaps from 30 to 35 per cent. to the third class.

Owing especially to the scarcity of good galena ores, all the attempts at smelting, with only one exception, have been metallurgical or financial failures. In some instances, this result was due to the management of the smelting operations by persons who seem to have believed that nothing was necessary to accomplish a success in that direction except common sense, fire-brick, ore, and wood. The results proved, of course, that a thorough knowledge of chemistry and metallurgy, combined with practical skill and experience, are indispensable. The exception above alluded to is the case of the smelting works of the Brown Silver Mining Company, which have succeeded thus far in paying the stockholders a dividend of one per cent. per month. The present manager of those works gathered experience in former attempts, which were made on Baker , and resulted unsuccessfully. At the Brown works, skillful men are ployed for smelting and cupelling, and exceedingly rich ore is delivered the works from the mine. By buying galena ores in Central and vada, and mixing them with the ores from the Brown and Coin, which tain comparatively little galena but much black zinc blende, one of main mistakes which were made in the former smelting operations h Baker ore is wholly avoided. These latter ores contain less than per cent. of lead, and smelting them without even a previous roast- was necessarily a failure.

Another attempt, made in the winter of 1867 and 1868, by Schirmer & ickner, was also a success, at least in regard to the metallurgical ults obtained. These were highly satisfactory. In every campaign ept the last one, more than 95 per cent. of the contents of the ore in cious metal were obtained. During the unsuccessful campaign they d to smelt Terrible ore, containing only 20 per cent. of lead.

n a financial point of view, however, they failed entirely, owing to eral adverse circumstances. They leased the Georgetown Silver elting Company's works on very unfavorable conditions for the six ter months. At this time of the year ores are extremely scarce, the consequence was that they were running not much over one- d of the time. Furthermore, they built a new smelting furnace, ch, according to contract, became the property of the company r the expiration of the lease without any compensation. Though expense of building it did not exceed $1,500, even that amount heavy investment, if it has to be paid back from the earnings of ll works in six months. The furnace itself, used with the best results Mr. Brückner in South America, and resembling very much the so- ed Küstel's furnace, worked admirably, and must be highly recom- ded, as a comparatively large quantity of ore (from three to four) may be treated by it daily with a small amount of fuel. Another ce of constant trouble and expense to them was the turbine which ished the motive power for the fan-blower. The water could not kept running, and finally an engine had to be substituted. With many unfavorable circumstances surrounding them, it is not astonish- that they failed. If they had been able to secure a full supply of l galena ore a substantial success would undoubtedly have been eved. Under the circumstances, they have at least satisfactorily onstrated that the galena ores of the Territory can be made to yield 95 to 100 per cent. of the fire-assay by skillful handling.

veral trials with Scotch hearths, made by Professors Dibbin, Sto- Kane, and some others, also failed entirely. In some instances lead positively refused to make its appearance until, by the assist- of a colored man who had worked in the lead mines of Virginia, ore was made to reluctantly give up some of its lead, though not gh to encourage further work.

order to smelt the galena ores of this vicinity profitably, they t first to be roasted carefully at a gradually increasing heat until just begin to sinter. If the ore does not contain any quartz, about er cent. of quartz should be added. By roasting in this way a great of the galena is converted into sulphate and oxide of lead, both of h will be converted into metallic lead and sulphurous acid in con- with the undecomposed galena. A comparatively small amount of , averaging from 5 to 10 per cent. according to the smaller or larger entage of galena in the ore, will thus be needed in smelting. If possible, the galena present should not be less than 50 per cent. Af roasting, the ore, mixed with the necessary amount of iron and lime fluor spar, should be smelted in a reverberatory furnace like that e ployed by Schirmer & Brückner, or in a shaft furnace from 12 to 16 f high.

Raw amalgamation has been tried, both in Black Hawk and in Geor town, Blatchley's pans being used for the purpose. The results are s to have been very unsatisfactory, especially in Black Hawk. It is, ho ever, certain that there is a good deal of ore which can be treated qu successfully, and most economically, by raw amalgamation, though present this class is too poor to pay for the high rates of mining, hauli and materials. The hauling of the ores from the mines is especiall heavy item. As yet, roads have been built only to three lodes, Equator, Terrible, and Baker; three-quarters of all the ore has to packed down the hills on mules, and this involves an average expe per ton of ore of from $10 to $15, according to the more or less fav able location of the mine. As soon as this state of affairs is somew modified by the construction of good, substantial roads, and a reducti in the prices of mining and milling, all the low-grade ores will, perha be treated with advantage to the owners by raw amalgamation. T will considerably increase the bullion product.

By far the greatest part of all the ores produced is treated by ro ing with salt, and subsequent amalgamation. For this branch of bu ness there exist four reduction works, one of which, belonging to Pine Silver Mining Company, is not yet quite completed. Two of the the German Reduction Works, owned by L. Huepeden & Company, a the Baker Silver Mining Company's works, employ Brückner's revo ing roasting cylinders for roasting and Freiberg barrels for amalgam ing; the Pine Silver Mining Company have one of the cylinders, an think a Hepburn pan. Mr. Stewart roasts in reverberatory furnaces a amalgamates in Blatchley's pans. The object in roasting the silver with salt is, to convert all the different combinations of silver into ch ride, which will readily amalgamate. The highest degree of perfecti in this kind of roasting has been attained in Colorado by Willi Brückner's revolving cylinder, by which the ore is easily chloridized high as 95 per cent., and, when particular attention is paid, from 97 98 per cent. can be attained. Moreover, it consumes very little fu (three-quarters of a cord in twenty-four hours,) and ores containing too much galena are worked to the best advantage with only 5 per cent salt, if their contents in silver do not exceed $120 per ton. The late s cess of Mr. Stetefeldt's furnace at Reno, Nevada, may, however, eve ually supersede this furnace in Colorado, as it has an immensely lar capacity than Brückner's, while the perfection and economy in the ro ing is beyond any doubt.

The Brückner cylinder and process are fully described in another p of this report, and I give here only some additional facts relating to cost of construction and working expenses.

The cost of one of these furnaces, (without royalty,) including fou ation, rollers, fire-box, dust-chamber, and stack, varies according to lo circumstances, from $2,500 to $3,000. Three of them put up toget will cost from $6,500 to $7,500. The average capacity may be saf called four tons per diem. A short time ago the German Reducti Works treated in one cylinder as much as 30 tons in six days. Fo tons are roasted with three-fourths of a cord of wood; the ore is eas chloridized as high as ninety-five per cent., and one man is amply s ficient to run three furnaces. The average daily cost of roasting ore in Colorado, if three cylinders are worked, is as follows:

Wood for three cylinders, 2¼ cords, at $5	$11 25
Two roasters, at $4 each	8 00
Cleaning of furnaces and dust chambers once a week, one man at $3 50 for four hours' work	1 17
Oil, &c	50
Wear and tear, at 20 per cent. of $7,500	5 00
Total	25 92

Dividing by twelve, (the number of tons worked in three cylinders in a day,) we obtain $2 16, certainly a very small cost for roasting one ton. Formerly it was believed that only ores containing very little galena and zinc blende could be treated to advantage in this furnace, but owing to several alterations made in the manner of working by Huepeden, Wolters & Co., and another improvement by the inventor, almost any kind of ore is treated successfully and profitably. During the winter of 1868–'69, the German Reduction Works were lying idle about half the time for want of ore; and in order to keep the establishment going as much as possible, they had to take any kind of ore they could get. At that time they worked the hearth from the smelting furnaces, which must certainly be considered as very bad material for chloridizing roasting. The results obtained were, however, only very little inferior to the average; and the roasting itself was performed in nearly the same time.

The advantages offered by this furnace as compared with a reverberatory furnace, are the following: 1. The capacity is larger; 2. It needs less fuel; 3. The ore is roasted uniformly; 4. No stirring of the ore by hand is required; 5. Less repairing of the apparatus is required.

Much benefit to the silver mines may be expected from the large dressing works, recently erected by Mr. Kurtz for the Wilson & Cass Gold Mining Company, in the most approved European style. They started operations early in the fall, and everything worked very well. If they are able to keep the works in full supply, they will doubtless have a perfect success in every respect. The capacity, however, being as much as 60 tons per day, I fear the supply will be very short for some time to come. In that case the work will perhaps not derive much profit this year. The main thing for which the miners have to thank these works, is a material reduction of the mill fees. By publishing a list of prices, according to which they intend to buy ores, they reduced mill fees from $60 to $45 per ton, in order to get their share of the ores. The other reduction works, of course, had to follow suit; and if only the prices for hauling and packing were reduced in the same proportion [illegible]-ore could be made to pay a handsome profit to the miner. A further reduction of mill fees is likely to occur whenever the supply of ores gets more limited. For more than a year this reduction of mill fees has been constantly called for as absolutely necessary in order to make the mines pay and the county prosper. This being done, now it becomes the duty of the miners and mine owners to do their share of the work also. They ought to do all in their power to get their mines into such a shape as to produce constantly and uniformly a supply of ore on the strength of which large works can be erected, which could and would work cheaper than small ones. If all the present works only were kept in full supply, which will require about 100 tons per day, a rapid change to the better in the condition of Colorado might confidently be expected, since the silver mines would then produce at least $2,500,000 instead of about

$200,000 of bullion; this would elevate the depressed business interests, expenses would be lower, and mining would be a legitimate business. Under the present circumstances the silver mines hardly produce bullion enough to pay for the immediate necessities of the population; and so long as such is the case a country cannot possibly accumulate wealth.

OTHER COUNTIES.

The silver mines of Summit County have not been developed to any extent; they are mostly strong, galena-bearing veins. Silver ores proper, especially brittle silver and ruby silver, are also found; a piece of the latter kind weighing seven pounds was taken from the Anglo-Norman lode. From a couple of hundred assays made by different parties, the probable average value of the galena ores is indicated to be about $100 per ton. It must be borne in mind, however, that the value of ores cannot reliably be ascertained for a whole vein by assays made of pieces. A great hinderance to the development of the lodes in this county, and the beneficiation of the ores, has been the enormous cost of transportation. At present, however, (September, 1869,) a wagon road is building from Georgetown to the Snake River mines, which will be completed within a few weeks; and doubtless the improved facilities for communication will reduce prices in every respect.

The other bullion-producing counties are Lake, Park, and Boulder. Lake County ranks first, as the gulches there yield, even now, a satisfactory amount of placer gold; they average from $5 to $10 per hand daily. Boulder just begins to rise from her sleep; work is commenced on the principal mines; and as they are paying just as well as they used to do before they passed into the hands of eastern companies, there is every reason to believe that with the increased activity of the population, and the advantage of having inexhaustible beds of excellent lignite, Boulder County will flourish again within a short time. The same will undoubtedly be the case in the other counties, but not being able to visit any of the mining counties, except Gilpin and Clear Creek, in person, I abstain from giving any statements in regard to them. I do not hesitate, however, to say that, judging by what trustworthy information I have about them, their mines and other resources seem second to none in the Territory. They are laboring as yet under disadvantages which are almost entirely removed in the counties of Gilpin and Clear Creek, and some time will be required to develop their resources.

BOULDER AND JEFFERSON COALS.

These counties are remarkable for the occurrence of large beds of lignite, which is pronounced by Professor Hayden to be superior to any found in the West, which, in all probability, will be found to a considerable extent stretching from north to south along the eastern declivity of the Rocky Mountains. Only at two points, however, in Colorado, are the beds well opened: at Bellemonte and Coal Creek. From the first place more than 50 tons per day are taken, and sold in Denver at from $10 to $12 per ton. Eleven different beds have been so far exposed, with layers of drab clay and sandstone between them. The coal obtained resembles anthracite very much in its outside appearance, but burns with a strong yellowish-white flame, gives little soot, and from two to three per cent. ashes of a reddish-yellow color. It leaves no clinker, and produces no more corrosive effects on stoves, grates, and oilers, than dry wood. It can, therefore, be used to great ad- e for generating steam and smelting ores.

analyses made by Dr. Torrey, of New York, gave the following :

	No. 1.	No. 2.
	12.00	20.00
matter	26.00	19.30
rbon	59.20	58.70
	2.80	2.00
	100.00	100.00

value of these beds of lignite is greatly enhanced by the sim- ous occurrence of fire-clay and iron ore. The former, found in from three to five feet thick between the different strata of coal, grayish blue color, burns almost white, and compares favorably e well-known standard clays of Europe. It has been used with t success in the manufacture of muffles and scorifiers for assaying, ing equal to this severe test, it may be pronounced sufficiently ory for all purposes. The iron ore occurs scattered over the sur- l the way from South Boulder to Coal Creek. At a depth not ing five feet, masses of a thousand pounds have been found in d, and though no defined bed has yet been discovered, the great y of superficial boulders gives ground for hope that such a de- xists. The ore found is probably a weathered spherosiderite, pearing as a limonite, containing from fifty to sixty per cent. of Besides the iron it contains alumina, silica, and some manganese, ds only very little lime as flux to yield an excellent pig-iron.

importance of these coal and iron beds for the whole region west Missouri river cannot be overestimated. Professor Hayden, in ort on the lignites of the West, says: "Indications of large de- f iron ore have been found in many other localities along the the Pacific railroads, and if the mineral fuel which is found here great abundance can be made useful for smelting purposes, these and iron ore beds will exert the same kind of influence over the s of the great West that Pennsylvania exerts over all the contig- ates. When we reflect that we have from 10,000 to 20,000 square f mineral fuel in the center of a region where, for a radius of 1,000 miles in every direction, there is little or no fuel either on or h the surface, the future value of these deposits cannot be over- ed."

ntly some trials have been made in Golden City to coke this hich are said to have given the most satisfactory results.

e South Park extensive salt springs occur, and large works have ected there, in 1866, by Rollins, Hall & Lane. The salt produced to be very pure; but owing to some cause, which I could not learn, ins from 13 to 14 per cent. of water.* The principal drawback to cess of this enterprise, however, is the fact that the company are to work so cheaply as to exclude the competition of eastern nd at present all the reduction works, so far as I know, get their of salt from the East.

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presence of moisture in the salt indicates, perhaps, a less purity than has been for the product. Is it not due to the presence of other chlorides, more hygro- an the chloride of sodium ?—R. W. R.

SECTION [illegible]

GENERAL GEOG[illegible]

In their course thr[illegible]
Rocky Mountains fo[illegible]
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northwestern and [illegible]
and a small part of [illegible]
latitude 40° north [illegible]
enter New Mexico [illegible]
ranges, the eastern [illegible]
continuous ridges of [illegible]
north of Santa Fe. [illegible]
tains of less heigh[illegible]
called, in New Me[illegible]
between the high [illegible]
Madre of the repub[illegible]
ing line of waters [illegible]
highest and most [illegible]
Luis Park, Southern [illegible]
range forms the water[illegible]

This peculiar formation [illegible]
its inconsiderable heigh[illegible]
north and south, and the [illegible]
edly point out the Territory [illegible]
the East and West; [illegible]
absence of deep snows [illegible]
for railroad lines.

On the eastern [illegible]
south of latitude 37°, [illegible]
Poñil, Cimarron,* [illegible]
of the Canadian [illegible]
Rio Grande.
Colorado, or [illegible]
Chimayó, P[illegible]
[illegible]
ast, that [illegible]

the 35th
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and Nav-
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7,177 feet
n a south-
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the west,
n Arizona
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plains. Be-
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which have been
t centuries, all of
en in another part

s mainly due to the
ne he[illegible]ers of the
the s[illegible]ry Cim-
s.) Th[illegible]are sit-
e from G[illegible]round
Mountain[illegible]reek
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m the tow[illegible]on,
pal minin[illegible]o-
west of th[illegible]

Accor[illegible]
Mo[illegible] feet

ony of the landscape is interrupted by several isolated and low mountain chains of short extent, the Cerillos, Old and New Placer, Sandia, Manzano, Organ, White and Sacramento Mountains, which can hardly be called a continuation of the Rocky Mountains. Most of them are composed mainly of syenitic rocks, which, during their upheaval, broke through palaeozoic sandstones and carboniferous limestones. These latter are found generally on the flanks of the ridges, but sometimes also on their top. Both the syenites and carboniferous limestones are traversed by mineral lodes. Dykes of porphyry are frequently met with near the lines of intersection, and have either caused much disturbance in the stratification or metamorphosis of the adjoining rocks. Between and surrounding these mountains is the high plateau of New Mexico, almost level, and mainly underlain by tertiary and lower cretaceous rocks. The sandstone forms frequently table mountains, (mesas,) and contains in many localities beds of lignite and bituminous coal, two to five feet thick, alternating with layers of iron ore, fire-clay, and shales. The latter are frequently filled with large fossil leaves. Wherever eruptions and overflows of porphyry have acted upon the formations containing coal the latter has been completely metamorphosed into a beautiful anthracite of excellent quality. This anthracite is proved to be of the same age as the lignites, by the fossils contained in the shales overlying both in the same succession. Variegated marls and beds of gypsum are exposed in many localities on this plateau. It is evident, therefore, that the larger portion of New Mexico has, in former ages, been a part of that large tertiary sea, which extended through nearly the whole section of the North American continent west of the Missouri, and forms now the eastern and western slopes of the Rocky Mountains. The many isolated mountains and short ranges in the Territory of New Mexico undoubtedly were as many islands in that sea, before that part of the continent reached its present elevation.

Another characteristic feature of the geology of New Mexico are the extensive layers of lava, spread in several localities horizontally on top of the sandstone strata. A very large area is covered by them, for instance, between the Raton Mountains and the Canadian River. The craters of now extinguished volcanoes are found in many parts of the Territory.

Not less interesting are the great number of deep cañons of many of the rivers and creeks in New Mexico. In the northern part of the Territory, for instance, the cañon of the Rio Grande, west of Taos, is over 1,000 feet deep, with walls perpendicular; the cañon of the Ocaté cuts through a mountain; it is so narrow that it cannot be seen until the traveler stands at the very brink of the precipice, and frequently the river appears to run up hill. A correspondent writes, "It seems to be unlikely that these deep cañons could have been formed by gradual erosion from the surface alone, and it is quite natural in this country, where subterranean rivers are yet of frequent occurrence, to think of these as one of the causes of these abnormally deep cuts. The subsequent breaking down of the overlying strata and the gradual washing out of the loose detritus would appear to be a more reasonable explanation of the phenomenon." I must decline, however, to accede to this hypothesis.

West of the Rio Grande del Norte, which traverses New Mexico from north to south, the same formations are met with as in the eastern part of the Territory. The principal mountains here are the San Juan Mountains, between the Conejos and Chama Rivers, affluents of the Rio *Grande*, and the Rio Blanco, one of the tributaries of the San Juan, an affluent of the Rio Colorado of Arizona; further south, near the 35th parallel, the Sierra Madre proper, which consists of several isolated mountain chains, with low passes between them. Zuñi Pass and Navajo Pass are the most prominent. The projected line of the Kansas Pacific railroad passes through the latter at an altitude of 7,177 feet above the sea. From Zuñi Pass the Sierra Madre extends in a southeastern direction toward the Rio Grande Del Norte. Here the Madalena Mountains are situated. Another chain passes thence to the west, culminating in the Sierra Blanco near the boundary line, in Arizona Territory. Still further south the Pinos Altos and the unapproachable Burros Mountains interrupt the monotony of the tertiary plains. Between the Rio Puerco and the Rio Grande west of Santa Fé are the Jemez, and still further west the Nacimiento Mountains; north of them, those of the Tierra Amarilla and Abiquiu. All of them are known to be filled with minerals, but in most of them prospecting has not been carried on sufficiently to permit of giving details in this connection in my present report.

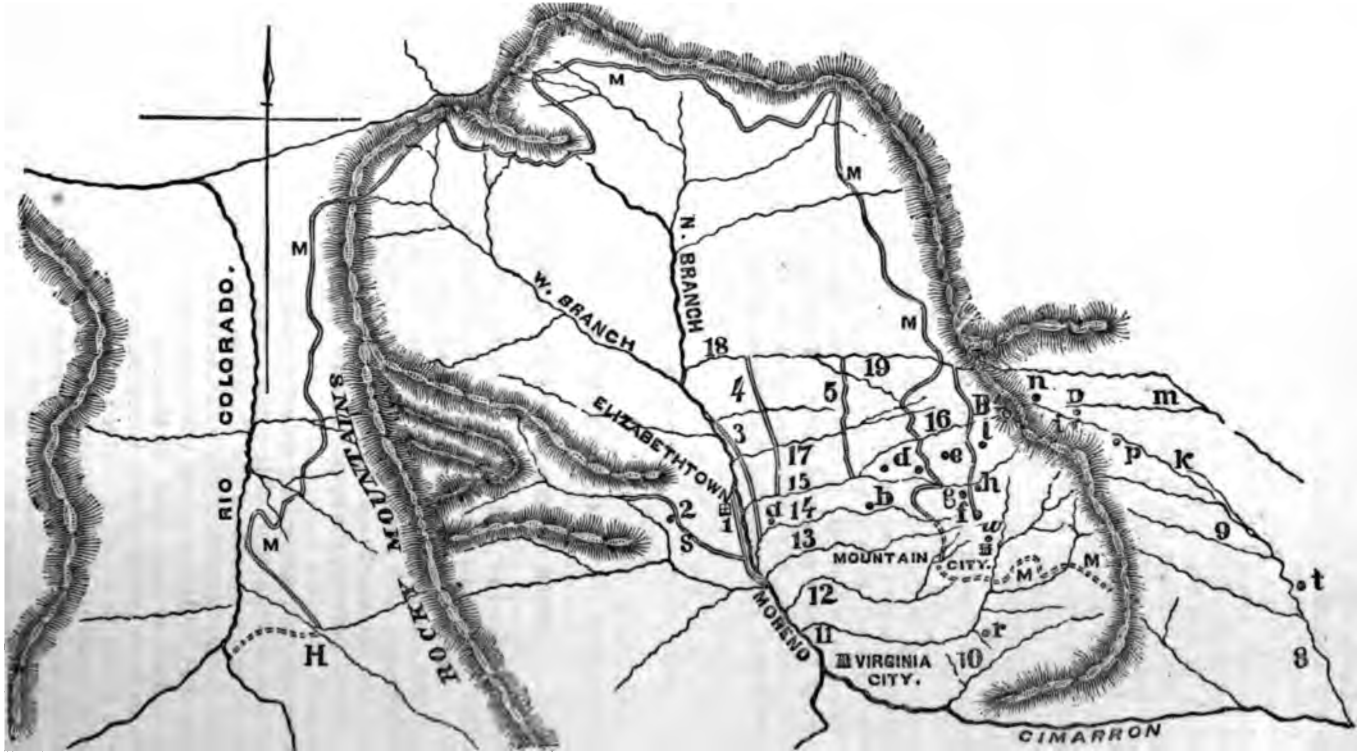
The climate of New Mexico is mild and very healthy, the sky as clear as that of Italy, and the air transparent and pure. In fact, the very act of breathing in this country makes existence in it a pleasure. The soil is fertile wherever water for irrigation is at hand. Most of the plains are covered with a very nutritious grass, (grama grass;) but some of them are waterless, dry deserts, so that artesian wells will have to be resorted to for a supply of water. The mountains are covered with pine, cedar, oak, &c., and, together with the flowery meadows in the valleys, present a very pleasing scenery to the eye.

CHAPTER LV.

THE MORENO GOLD FIELDS.

The total product of gold of this Territory for the year from July 1, 868, to July 1, 1869, is, according to the best informed sources, $500,000, coin value. There was no silver produced during the year, with the exeption of the small quantity which occurred alloyed with gold. Although there are rich silver mines in the Territory, which have been worked by the Spaniards and Mexicans during the past centuries, all of them lie idle at present, for reasons which will be given in another part f this report.

The increase over the gold product of last year is mainly due to the iscovery and development of the new mines on the headwaters of the Cimarron River, a branch of the Canadian, (not the so-called dry Cimmaron, which empties directly into the Arkansas.) These mines are situate under 36° 30′ latitude and 105° longitude from Greenwich, around Baldy Mountain, a high peak in the Rocky Mountains, on Ute Creek and Moreno River, both of which are affluents of the Cimarron. The Ute Creek mines lie about seventeen miles from the town of Cimarron, Maxwell's Ranch;) Elizabethtown, the principal mining town of Moreno district, is situate about twenty-seven miles west of the town of Cimarron, and thirty-five miles northeast of Taos. According to Mr. M. Bloomfield's measurement, Baldy Mountain is 12,908 feet high.



1. Benjamin's ditch. 2. Comanche ditch. 3. Pollock ditch. 4. Michigan Company's ditch. 5. Grouse Gulch ditch. 6. Maxwell's ditch. 7. Pońil River. 8. Ute Creek. 9. Green's Gulch. 10. Cañon Creek. 11. Willow Creek. 12. Mexican Gulch. 13. Amite Gulch. 14. Grouse Gulch. 15. Humbug Gulch. 16. Negro Gulch. 17. Pine Tree Gulch. 18. Mills Gulch. 19. Spring Gulch. M. Moreno ditch. B. Baldy Mountain. H. Head of Moreno ditch. *a.* Great Eastern claim. *b.* Pacific claim. *c.* Eureka claim. *d.* Continental claim. *e.* [illegible] claim. *f.* Maxwell's reservoir. *g.* North Star claim. *h.* Union claim. *i.* Wisconsin. *k.* Montezuma. *l.* Diddie. *m.* Aztec. *n.* Comstock. *o.* Aztec quartz mill. *p.* [illegible] mill. *r.* Arthur's. *s.* Comanche reservoir. *t.* Maxwell's. *w.* Collins.

he three principal mining districts organized in this region are:

. Ute Creek district on the east side;

. Willow Creek district on the south side; and

Elizabethtown on the west side of Baldy Mountain.

UTE CREEK DISTRICT.

he *Aztec Mine* is situate between Ute Creek and the Poñil River, in ange of silicious slate, which extends in an eastern direction from the t of Baldy Mountain. It was discovered in the spring of 1868, by ee miners, Lynch, Dogherty, and Fosley. These men, while pros- ting at the base of the range, found some "float" quartz, rich in gold, ich they traced to a "slide" forming a depression of the surface partly ed with decomposed vein matter. This material yielded as high as o and three dollars to the pan, (about twenty pounds of "dirt" or aurif- ous gravel.) On this "slide" they worked for a while and finally found e lode higher up and nearly on top of the hill, at a point where the esent main shaft is located. Two thousand feet east and one thousand t west of this shaft are owned by the company—L. B. Maxwell ning seven-twelfths, J. Dold one-sixth, Colonel Bergman one-twelfth, elby one-twelfth, and Lynch one-twelfth.

The shaft sunk on the property is ten by seven feet in the clear, and 0 feet deep. It follows the dip of the lode for about 90 feet at an gle of 75° northeast. At a depth of about 35 feet two drifts have en run into the lode in opposite directions, one bearing north 41° st, the other south 36° east. The drift toward the west is 120 feet, and at toward the east 110 feet long. The dip of the vein near the end f the latter drift is 65° northeast; its width in these openings is vari- ble from a few inches to four feet. To within 90 feet from the surface th strike and dip of the lode are remarkably regular, but below that pth the dip changes very suddenly from 75° to nearly horizontal, and e bearing, which in the upper part of the shaft was north 56° west, ns apparently to north 71° west. It must be remarked, however, at correct observations are very difficult in a labyrinth of drifts, the nning and working of which certainly surpasses any irregularity ich the lode itself may present to the eyes of men not used to mining veins and unable to explain to themselves such disturbances, as in er mining countries are perfectly understood.

n this case a second vein, in places very rich and three and one-half t wide, joins the lode. This is the true cause of the variation in strike d dip above spoken of. But, under these circumstances, it may be fidently expected that the irregularity appearing so great to inexpe- nced eyes, will be proved to be of little import by future develop- nts. Although the strike of the lode may remain a different one m that found above, the former dip of the vein is very likely to ap- r again a little lower down. Some more iron and copper pyrites will doubtedly make their appearance, and lean streaks may occur; but vertheless, if the lode is worked according to a regular system, and ecially if particular attention is paid to the constant development of w ore bodies in such a manner that sufficient reserves are always on nd for a steady supply of the mill, the vein will undoubtedly deserve be called an uncommonly rich one.

he quartz of the Aztec contains, like nearly all the gold ores of that gion, a large proportion of peroxide of iron, which gives it a brown lor, similar to that of the Colorado surface ores. This ingredient is doubtedly the product of the decomposition of iron pyrites. Some decomposed feldspar, quartz in crystals, and occasionally a little carb nate and sulphate of copper, are also present. A seam of copper pyrit is found in the bottom of the shaft. The slate, thin layers of which o cur in the lode, is often stained green by copper salts and contains fi gold. So far all the gold is found to be perfectly free from any coati generally finer than common gunpowder, and on an average much smal in size than that found in the gulch claims below the lode. Wire gol met with occasionally.

The Aztec mill is owned by the same parties who own the mine. is situate on Ute Creek, in a well-watered and heavily-timbered regi and, according to measurements made by Mr. Bloomfield, 10,790 f above the sea. A tramway 1,675 feet long has been constructed carry the ore from the mine to the mill. The latter contains stamps, was built by the Eagle foundery at Chicago, and cost, includi freight, $8,000. The stamps weigh 425 pounds each, and drop at t rate of 33 times per minute. They are propelled by a twelve hor power stationary engine. Nearly all the gold is amalgamated in t battery-box and a very small proportion only is taken from the amalg mated copper plates. A "clean-up" is generally made every other da and the plates are washed with a solution of cyanide of potassiu The strained amalgam yields by retorting about half its weight in go of very good quality. A lot of retorted gold from this mill, sent to t United States assay office at New York, assayed .835½ in gold and .1 in silver; another lot from the same mill, weighing 266.80 ounces, a sayed .841 in gold, and .152 in silver; coin value $4,613 43; curren value $6,282 17, less $6 38 taxes=$6,275 79 net. Five men are em ployed in this mill, and one of the owners is the superintendent. Eighte to twenty men are working in the mine, and keep four drills running i the day-time and two at night. Wood costs $2 35 per cord at the mil From $2 to $2 50 and board is paid to the men; board is $1 per da Lumber delivered at the mill costs $30, and mining timbers $15 pe thousand feet. Freight from Sheridan, the terminus of the Kansa Pacific railroad, to the mines costs two and a half cents per pound, an from St. Louis five and a half cents.

The mill commenced crushing rock October 29, 1869. Colonel Ber man has kindly furnished me with an account of the work done; th yield of gold bullion is taken from the books of the Aztec Company:

October, 1868, *to April*, 1869.

	Working days.	No. tons cru
October	3	[illegible]
November	14	[illegible]
December	6	[illegible]
January	16	[illegible]
February	16	[illegible]
March and April	16	[illegible]
Total	71	[illegible]

Which yielded 1,678 oz. 7 dwt. 13 grains of gold. This, sold at $22 currency per o amounted to $36,823 50.

April 12 *to July* 1, 1869.

	Oz.	dwt.	[illegible]
April 13, cleaned up	58	16	[illegible]
April 14, cleaned up	76	17	[illegible]
April 17, cleaned up	230	2	
April 21, cleaned up	47	1	
May 4, cleaned up	27	14	[illegible]
May 4, cleaned up	248	5	[illegible]

	Oz.	dwt.	grs.
7, cleaned up	111	7	
8, cleaned up	327	1	12
20, cleaned up	681	1	
26, cleaned up	92	15	
2, cleaned up	95	5	
3, cleaned up	132	11	12
3, cleaned up	132	19	12
3, cleaned up	23	19	12
1, cleaned up	216	9	12
, cleaned up	45	10	12
0, cleaned up	13	10	12
0, cleaned up	210	11	12
0, cleaned up	151	2	17
3, cleaned up	116	17	17
7, cleaned up	97	7	7
	3,003	14	6

at $22 currency per oz., $66,081 67.
ber of working days, 64; number of tons crushed, 960.
ge yield of ore, $68 83 currency.

Recapitulation,

	Quantity crushed.	Yield.			Value.
	Tons.	*Ozs.*	*dwt.*	*grs.*	
, 1868, to April 12, 1869	850	1,678	7	13	$36,923 50
1869, to July 1, 1869	960	3,003	14	6	66,081 67
l	1,810	4,682	1	19	103,005 17

ge yield per ton of ore, $56 90 currency.
the month of May, 1869, the mill was run for one week on very rich ore, elded at the rate of $3,000 per day.

Yield of Aztec mill from July 1 *to August* 4, 1869.

Oz.	dwt.	grs.
157	8	0
18	7	0
53	4	0
103	11	12
88	12	12
140	16	19
103	8	12
86	16	18

above statistics speak exceedingly well for the richness of the

Big Jacko or *Montezuma* lode was discovered lately by a miner Big Jack, between Ute Creek and Black Horse gulch, within half of the Aztec mill. It is reported to be even richer than the L. B. Maxwell, the owner of the grant, is the principal share- in this claim, which is 3,000 feet long. He is putting up a 30- mill, 15 of which will be in operation by the end of October, The lode has been traced for about one mile. The discovery 50 and another shaft 40 feet deep. A tunnel, running on the s been commenced, which is intended to strike the discovery t a depth of 300 feet. About 600 tons of ore have been extracted. st-runs at the Aztec mill have given a result of $75 per ton, and ance of the ore is expected to yield fully as high.

iderable excitement prevails on account of this new discovery, lonel Watts, who has seen it, calls it the best lode in America. deed, if it does all it is expected to do, viz., if it is able to supply regularly a 30 stamp mill with ore containing $75 gold ton, it may well be called not alone the best lode in America, but in world; especially if we consider that the cost of working the mine sh be comparatively low, while the gold occurs in a free state, so the cheapest of all processes, the common stamp mill process, ca profitably employed.

The cost of extracting and milling one ton in Ute district is estim at $10 to $20, according to the size of ore bodies met with, and to or less skill and economy in the management. This is higher tha should be.

Considerable prospecting has been done during this year on the ri near the Poñil River, north of Ute Creek, and many leads were di ered. The following are a few of them: The *Swansea* lead, shaft 20 deep; the *Gates* lead, shaft sunk 13 feet. The ore of both is sai yield a fair prospect in the pan. The *Frenchman's* lead is situat tween the Swansea and Gates. The *Stonewall* lead is reported encased by a hanging wall of granite and a foot-wall of slate. A 28 feet deep is sunk high up on the hill; one 10 feet deep lower d on the slope. The *Chico* lead is a two-inch crevice, which is sai prospect well. A shaft has been sunk on it to a depth of 25 feet.

The gulches on the east side of Baldy Mountain, though prosp very little so far, are all said to contain gold. On the Poñil, pil stones are found, said to be the remains of ancient washings by Spaniards and Mexicans. The part of Ute Creek between the A mill and Mr. Maxwell's house has been most thoroughly explored. mediately below the Aztec mill some very coarse gold has been fo A specimen now in Mr. Brueckner's collection contains so much gold in a brown ferruginous mass, that of the whole weight of one o four-fifths are gold. It has undoubtedly been washed down with detritus from the Aztec lode. A $40 nugget was taken out on Jul 1869. Most of the metal taken up on Ute Creek so far is leaf-gold of which is very coarse. The finer kind, of which the ore of the A contains a great deal, has probably been deposited further down gulch, where the grade is less steep. The gold washed out now i coarse that the use of quicksilver in the flumes could be entirely pensed with. Machinery for hydraulic washings has been put up in localities—near the Aztec mill and near Mr. Maxwell's house, sev miles below the mill. Out of one of these claims $1,700 were take six weeks. The highest yield taken out of any gulch claim on Ute C in one week was $700. The gold does not occur everywhere in gulch, but is rather "spotted." Thirty-five men in all are workin these claims. At the hydraulic works near Maxwell's house the rock, which consists of siliceous slate, lies from 10 to 30 feet deep. B. Maxwell, who owns the claim, employs six men at a time, and hose supplied with about 150 inches of water, miner's measurem The sluices are provided with log riffles. One foot of cement imm ately on the bed-rock is exceedingly rich in gold.

It appears to be the opinion of the miners generally that the gul on the east side of Baldy Mountain (Ute district) are not as ric those on the west side, (Moreno district,) but that the lodes in former are better on account of the greater regularity of the cou rock.

WILLOW CREEK DISTRICT.

A man by the name of Kelley discovered gold in Willow Gulch October, 1866. The secret was kept pretty well during the winter, gh leaked out to cause some excitement; and when Arthur and son came out in May, 1867, to follow up Kelley's discovery, they d a party of miners already at work in Michigan Gulch, where they liscovered gold near the present site of Elizabethtown. Arthur & Co. pected during that season in Willow Gulch, took out 14 ounces of , and concluded to work on a larger scale. For that purpose they red for themselves the water of Bear and Willow Gulches. Their ng property consists of one hill claim of 1,600 feet, 600 of which bought of L. B. Maxwell for $1,500, and 1,600 feet of ground on ow Creek. The claims were opened, ditches and a reservoir dug, houses built at an expense of about $14,000. Operations were com- ced in April, 1868, and by November 20 of the same year the com- had taken out about 400 ounces of gold, worth $8,000 currency, 1 the inclemency of the weather stopped their operations. They nenced work again April 3, 1869, and by July 1 of the same year had taken out 327 ounces, 10 pennyweights, 22 grains. The gold very fine, as will be seen by the following two memoranda of bul- shipped by Arthur & Co. to the United States branch mint at Den- for assay.

should be remarked here that bullion shipped from New Mexico Wyoming to Denver banking-houses for assay at the mint is gen- y credited to Colorado Territory.

randum of gold bullion deposited at the branch mint of the United States at Denver, Colorado, the 9th day of July, 1869, by First National Bank, Denver.

cription of bullion.	WEIGHT.		ASSAY.		Whole value.	Mint charges.	Net value.	RETURNED TO DE-POSITOR.	
	Before smelting.	After smelting.	Gold.	Silver.				Gold bar.	Change.
1	*Ounces.* 14. 79	*Ounces.* 13. 67	892½	104	$254 05	$0, 641	$253 41	$252 37	$1 04
turned ; No. ounces 13. 58.								252 37	
								1 04	
								253 41	
3	76. 32	72. 04	881	116	1, 322 79	3 31	1, 319 48	1, 319 30	18
turned ; No. ounces 71. 85.								1, 319 30	
								18	
								1, 319 48	

JACOB F. S. SHIRMER,
Assayer of Branch Mint.
By AMOS LAUZ.

uring the month of July, 1869, 136 ounces, 16 pennyweights, 11 ns were taken out by the same company. Their total product since il 3d of the same year was, therefore, 464 ounces, worth $10,347 20 ency. This amount was taken out by 886 shifts of one man, cor- onding to $11 67 per hand.

ork on the hill claim by hydraulics was commenced on the 4th May, . The company have 54 feet pressure and use a 6-inch hose with a 1¼-inch nozzle and 40 inches of water, miner's measurement. Four men took out 33 ounces of gold in five weeks. The gold was entirely different from that taken from the gulch claim immediately adjoining. It was much coarser, much finer in quality, and very rusty, so that quicksilver would not take hold of it. Mr. Brückner has inspected some of the dust, and as he found it very rough, he came to the conclusion that it could not have traveled very far from the original deposit. Some large pieces of float quartz and indications of a lode near the reservoir, at the intersection of the slate and granite, were found by him. The sluice boxes on this claim are 200 feet long and have 10 inches fall per box of 12 feet in length. At the creek claim the same party had a tail-sluice of 1,200 feet in length with 575 feet of wing sluices. At present they have a force of eleven men at work, but in May and June, when water is more plentiful, seventeen men are employed. In the month of August, during Mr. Brückner's visit, the amount of water furnished by the creek was 100 inches, and by the reservoir, which was allowed to fill at night for use in the day time, 70 inches, while in May and June a full supply of 250 inches can be had. The amount of ground worked out in the creek claim was 175 feet in length. The full length of each claim on Willow Creek is 200 feet, and its width is determined by the width of the gulch. Hill claims are 300 feet square. In that portion of Willow Gulch where Arthur & Company are at work, the surface of the ground falls 11 inches to every 12 feet, which is the length of a sluice-box. As only 7 inches of fall are required per box, 4 inches are left for dumping; this circumstance facilitates operations considerably, as no extra hands are required to shovel off the tailings from the end of the boxes. The drift and gravel are 13 feet deep from the surface to the bed rock; some of the boulders are very large, but as much as a 15-pound stone is carried through the sluices by a current of 170 inches. It is estimated that an area of ground 10 feet long, 16 feet wide, and 13 feet deep, is worked out every day. Log riffles about 6 inches high are used in preference to common sawed riffles. The cost of both is about the same, but the former last three times as long as the latter, for the reason that the grain of the wood resists the friction of the gravel much better than the fiber. In the first two boxes next to the sluice-head, slot riffles are used. About six pounds of quicksilver per day are distributed in all but the two last sluices at different times; the two last serve merely to catch any quicksilver which may have been washed that far by the force of the stream. On cleaning up, about 75 per cent. of the quicksilver is found in the first box, the balance is deposited in the following boxes in quantities proportional to their distances from the sluice-head. The cost of a sluice-box, including five log riffles and two cleats, is $5.

I have given such a detailed description of the claims of Arthur & Company because they are considered, and really are, models of well-conducted, economical, and business-like sluicing and gulch mining.

Willow Gulch is about four and a half miles long from its commencement at the western slope of Baldy Mountain to its junction with the Moreno River; it follows a general north and south course. Above Arthur's claim, which is situate about three-quarters of a mile above the mouth of the gulch, the valley becomes steeper and narrower, especially in the neighborhood of Mountain City, a town at the junction of New Orleans Flat and Last Chance Gulch. Below Arthur's, it widens out gradually down to the Moreno Valley, where Virginia City is situate.

A great many claims have been located both above and below thur's. Above, are the following:

Middleton & Company's, rich in gold; water very scarce at present.

The *Union Company's*, a claim 1,600 feet long; ground 10 to 20 feet ck has to be removed before the pay-gravel, 4½ feet thick, is reached. e richest part of the latter is immediately on the bed-rock, like in st of the Moreno gulches. This company uses 14-inch sluices and about 75 inches of water at its disposal. The gulch is narrow and tains large stones. The fall of the surface is 15 inches in 12 feet.

The *Idaho Company's*. The claim is 1,000 feet long and 110 feet wide, l falls 13 inches to every 12 feet. The supply of water is 80 inches.

Dutch John's. Location 800 feet long and 200 feet wide. Amount of ter, 85 inches.

Below Arthur & Company's, the following claims are located:

The *Eureka Company's*. Work was commenced in May, 1868. The l-rock is 14 feet below the surface. Although the claim is considered h, very little work has been done.

Harrison & Company's.

Pope & Company's. Bed-rock 15 feet deep.

O. K. Company's. Bed-rock 20 feet deep.

The three last companies, though they have sunk prospecting shafts, ve not opened their claims. Below them, down to the junction of the lch with Moreno River, no prospecting shafts have been sunk yet.

In all the claims on Willow Creek sixty-three men were at work in gust, 1869.

The next gulch west of Willow Creek, and nearly parallel to it, is *rican Gulch*. It has been prospected and found to be rich in gold, t no ditch having been brought to the locality as yet, no actual min- has been done.

Baltimore Flat, south of Last Chance, empties into Mexican Gulch.

Further west, near Elizabethtown, some of the richest and most mising gulches in the Moreno gold fields are found. Grouse Gulch, mbug Gulch, Last Chance Gulch, and New Orleans Flat are the st important ones, as far as prospecting and actual work done up to present time indicate. Most of the richest claims, however, have y been worked during a few months when the supply of water was erably sufficient; now nearly all of them lie idle for want of water. is to be regretted that the ditch carrying water from the Red River, affluent of the Rio Grande, was not sufficiently perfected during last r to furnish the much hoped for supply. Of the 600 or 700 inches ich were turned into the ditch at its head from one of the branches the Red River, only 100 arrived at Humbug Gulch, and even this ount was diminishing daily on account of the enormous leakage along way. Much disappointment was therefore experienced by the ners, many of whom had opened their claims and were ready for lching.

There are only two ways for abating this evil; the whole extent of the ch must either be puddled thoroughly with clay, of which there is a at quantity near the head of the ditch, or the amount of water must increased at the head by carrying another branch of Red River to it. e latter proposition would necessitate the construction of an addi- nal ditch of several miles in length.

The prosperity of the Moreno gulch mines, depending largely on the edy completion and perfection of this ditch, it may not be inappro- iate to give here a more detailed description of it.

The length of the ditch from the Red River to Grouse Gulch is 41

miles 10 chains. Along this distance 3 miles and 29 chains of aq
and side hill flumes were necessary. The greatest distance spa
one aqueduct is 144 rods, over a valley 79 feet deep under the ce
is situate at the divide of Red and Moreno Rivers, one of whi
into the Rio Grande, the other into the Canadian and Mississip
Mill's Gulch the ditch is carried along the top of the ridge.
first 12½ miles its fall is 12 feet, the width at the bottom 2½, an
top 5½ feet by 2 feet in depth, and a slope of the back bank of
in 12 inches; for the remainder of the way the fall is 4 feet per m
width 4 feet in the bottom, and 7 feet at the top by two feet i
For 5 miles the ditch had to be blasted through bed rock; n
was required, but several cuts 10 feet deep had to be made. Th
on the 12 feet grade are 4½ feet wide and 30 inches deep, on t
grade 3 feet wide by the same depth as the first mentioned.
tance between the head of the ditch and Grouse Gulch is only

The distance from the east to the west branch of Red Riv
miles. The two combined are expected to give a supply of 60
measured under a pressure of five inches. Work was comme
May 12, 1868 and carried on until November 13, of the same y
portion of the ditch was made by contract. Four hundred and
men were the highest number employed at one time. The fi
was delivered to Martin & Scott's claim in Humbug Gulch on Jul

According to Captain Davis, there was not one mile of grou
the whole length of the ditch which would not show the color
in prospecting.

The gold diggings on Red River have, however, not been ope
the depth of the bed rock has only been ascertained to be ver
erable. The valley is one of the most beautiful in New Mexico.
ows covered with flowers of all colors, a clear cold stream of w
of trout, and sombre mountain sides covered with a thick gr
pine, remind the visitor forcibly of the mountain scenery of the
gian Forest.

Water rates of the Moreno Water and Mining Company, Moreno mines. Cost of ditch

No. of inches.	FIRST WATER.			SECOND WATER.			Remarks.
	Day.	Night.	24 hours.	Day.	Night.	24 hours.	
30	$15 00	$10 00	$25 00	$7 50	$5 00	$12 50	Third water according to contr
40	20 00	13 33	33 33	10 00	6 67	16 67	
50	20 00	13 33	33 33	10 00	6 67	16 67	Water delivered under a pres inches.
60	24 00	16 00	40 00	12 00	8 00	20 00	
70	28 00	18 67	46 67	14 00	9 33	23 33	
80	32 00	21 33	53 33	16 00	10 67	26 67	
100	33 33	22 22	55 55	16 67	11 11	27 78	
150	50 00	33 33	83 33	25 00	16 67	41 67	

of water sold by Moreno Water and Mining Company, during the week ending August 7, 1869.

ame of claim.	Location.	First water.	Second water.	Third water.	Days.	Nights.	Rates.	Amount.
& Faulkner	Humbug Gulch	100			6	6	$55 55	$333 30
Hageler	McNulty Gulch	60			4		24 00	96 00
Hageler	McNulty Gulch	60				1	16 00	16 00
& Company	Little Negro Gulch	50			6		20 00	120 00
& Sears	Missouri Gulch	100				2	22 22	44 44
& Sears	Missouri Gulch	70				2	18 67	37 34
n Bros	Little Negro Gulch	50				3	13 33	40 00
nce Company	Humbug Gulch		50		4		10 00	40 00
Clifford	Big Negro Gulch		50		4½		10 00	45 00
ia Company	Humbug Gulch			60	5½	3	Contract.	60 30
Bergman	Humbug Gulch			100	4		Contract.	40 0
& Company	Michigan Gulch			60	3½		Contract.	28 00
& Company	Michigan Gulch			60		3	Contract.	22 00
n Company	Michigan Gulch			60	3			20 00
al								948 3

e level of Moreno ditch at Negro Gulch is 10,570 feet above tide-
; the elevation of Elizabethtown being 9,497 feet, the ditch at
o Gulch lies 1,073 feet above Elizabethtown. Within this difference
itude a great deal of very rich ground is located, but some of the
st lying higher up on Baldy Mountain cannot be supplied with
from this ditch. For this reason a ditch from the Poñil River was
ht around the mountain by Mr. Maxwell at an elevation of 10,904
nd thence to a point on New Orleans Flat, where he commenced a
voir. He is said to have already taken a large amount of gold from
aims on Last Chance Gulch, to which the water was brought hitherto
Willow Creek.

ides the above two, several other ditches have been constructed to
h water to the claims situate lower down near Elizabethtown and
sh Bar; as, for instance, the *Michigan* ditch, carrying water from
Gulch to Michigan Gulch; *Bergmann's Moreno ditch*, which brings
vater of Moreno River, and *Comanche ditch*, which brings it from
nche Creek to Spanish Bar; *Carpenter's ditch*, bringing water to the
voir in the lower part, and *Pollock's ditch*, carrying water to the dig-
at the mouth of Grouse Gulch.

ims in Grouse Gulch.—Carpenter's property consists of eight claims
0 feet square each, of which Tom Lothian owns five, George M.
enter one and a half, John G. Schuhurann one, and Joe Bryant
alf. The tract is situated at a point of the gulch, where it forms a
w, covered with meadows, between gradually sloping hills studded
pine trees. In the open cut, in which sluice-boxes are arranged,
rs nearest to the surface a layer of earth, six feet thick; next to it
n feet of yellow gravel with boulders of slate, granite and quartz,
average size of about six inches in diameter. These boulders are
little rounded. The layers slope with the surface of the hill from
outheast to west-northwest, and also from east to west. The bed
dips toward the south, and is a soft, decomposed red slate. Im-
ately on it lie about eight feet of pay gravel. A rich prospect of
ling coarse, rough gold was obtained from five pounds of "dirt"
from the middle of the pay streak; the bottom showed less gold.
company have 500 feet of hose on hand, and intend to commence
ulic operations as soon as they can get a sufficient supply of water

from the ditch company. Their present supply from their own ditch is too small to carry on such works without much interruption. Their sluice-boxes have seven inches fall to every 12 feet, and are 12 inches wide. Slot riffles are used in the upper and block riffles in the lower boxes. One thousand feet of flume are on hand. In their open cut, which is eighty feet wide, they find the gold very evenly distributed, and as it is very rough, they are confident that the mother lodes are near by in the foot-hills. Work on the claim was commenced November 1, 1867. The cost of opening it was $8,000. Fifteen hundred feet of lumber, worth $75, and 75 pounds of nails, worth $15, were used on the claim. Since May 10, 1869, the company have washed 1,700 cubic yards of pay gravel, and have produced therefrom 142 ounces 14 pennyweights 19 grains of gold, which sold at $22 20 per ounce. The total number of working days was 162; sluicing 27 days. Cost of a day's work, $2 75; board, $1 25; daily supply of water, (70 inches,) $6. Twenty-five pounds of quicksilver, worth $37 50, were used.

Calhoun's claim, owned by Calhoun, Deacon and Sullivan, is 1,250 feet long, and is of a similar character to Carpenter's, which joins it below. Their pay streak, lying on a blue cement-like slate, is eight feet thick, and contains magnetic iron sand, the "marmaje" of the Mexicans, and small lumps of magnetic iron, (called "tepustete" or "la guia del oro,") like all the Moreno diggings, and in fact most of the best placers in the world.

The gold is coarser than at Carpenter's, and sometimes has osmiridium adhering to it. This company is said to have taken out $6,200 worth of gold during last year, and $2,000 worth this spring, during only five or six weeks of actual work. The gulch is 80 feet wide at this claim, and the ground has a fall of 18 inches in every 12 feet. The company is prepared to work by hydraulics, and has on hand 250 feet of seamless hemp hose, costing $1 90 per foot. They will work under a pressure of 125 feet. Judging from their present prospects, they expect to be able to take out $200 worth of gold per day, as soon as they can get enough water from the ditch.

Above Calhoun's claim Grouse Gulch gets narrower and steeper. Along its whole length of two and one-half miles claims have been located. The following are some of them: Mallory & Co., 1,200 feet; Riley & Co., 600 feet; Bergmann, 600 feet; Ned. Pointer, 600 feet. All of them are waiting for water from the Moreno ditch. Below Carpenter's the Michigan Company, Pollock, and others, have claims. The latter is taking out a comparatively large amount of gold every week. Below his claim the ground has not fall enough to permit successful sluicing; several men working with a "long tom," however, made good wages.

Humbug Gulch, situate next to Grouse Gulch, toward the north, runs parallel with it, and is much longer.

Among the more prominent claims in this gulch is *Martin & Scott's* hydraulic claim, 1,500 feet long. The company have made a small, open cut, of 22 feet in depth, in which they found 6 feet of pay-gravel without having reached the bed-rock. As the ground rises they will probably find it soon. They work day and night, with a force of 30 men, and 50 inches first and the same amount of second water, under a head of 75 feet, using a 6-inch hose with a $1\frac{1}{4}$-inch nozzle. Eighteen sluice-boxes, with a fall of 7 inches per box, have been put down.

Faulkner & Coleman's claim. The ground prospects well 5 feet below the grass root, but the amount of water at their disposal, 50 inches, is insufficient for successful working.

The California Company's claim, 2,700 feet long, contains a layer of ay-gravel 10 feet thick. The absence of large boulders facilitates perations greatly. The company work on a bottom of clay, large umps and layers of which occur also in the pay-streak. They took ut $452 with eight men in six days.

Bergmann's claim, near the junction of Humbug Gulch and Moreno River.

All of these claims are depending on the perfection of the Moreno itch for successful working.

The diggings of *Spanish Bar*, one-half mile below Elizabethtown, near he Moreno River, present some remarkable features. Gold is here ound at an elevation of from 20 to 30 feet above the present river bed, n the banks, and the bar diggings have been much richer than the river diggings below. Colonel Bergmann, for instance, has taken from his Spanish Bar claim about 15 ounces of gold per week, working in day-time only, and with less labor than in his river diggings, where not more than about seven ounces per week were taken out by working day and night with a greater number of men. Many theories have been adanced to explain this strange freak in Nature's dressing process. According to one, the gold has come from lodes on the hill, above the laim; another sets forth that the gold was deposited here at a time hen the river bed was at a level with the bar, and that afterward the iver bed was washed deeper, while the former plentiful supply of gold iminished; still another assumes, that the bank has been raised by volnic action subsequent to the deposition of the gold. The following exanation, however, deduced from the observation of the character of the ld and the appearance of the bed-rock, is probably the right one: The untry rock consists of a stratified porphyry-like conglomerate of quartz, ldspar, hornblende, and mica, including irregular grains of quartz and lcite, larger than the other component ingredients; it strikes northast and southeast, and dips 75° southwest, into the hill. Interstratified ams of decomposed iron-stained quartz and feldspar, full of little creves, occur frequently, and in places they form a regular network. The all crevices are filled with auriferous sand, containing rough laminar ld, with sharp points and angles. It has paid in places to work out d sluice the bed-rock to a depth of over five feet, and it is, therefore, ely that the gold originated where it is found. In the richest spots e ground is stained red and yellow, and in these places the most evices are always found.

In many of the other gulches good prospects of gold have been found. will only name here the following: *Spruce*, *Pine*, *Spring*, *Mills*, *Nacita* *Rocky Point*, and *Missouri Gulch*, *Grupp*, *Eagle*, and *Only Chance Flat*, *easure Hill*, *Six Mile*, and *Cienegilla Creek*.

I cannot conclude this description of the Moreno gold fields without lling attention to Moreno Valley, between Spanish Bar and the juncon of the river with the Cienega and the Cimarron River. Here the alley forms a deep and wide basin, between high hills, and has eviently been the bottom of a lake before the water forced an outlet to e steep cañon of the Cimarron. All the main gulches of Moreno, like Willow Creek, Mexican Gulch, Rocky Point Gulch, &c., empty into this asin, and it is therefore very probable that a large amount of fine gold as been washed into it. Thorough prospecting by shafts and wells ould soon test this question, and if prospects should warrant the outay, a tunnel should be driven from Cimarron Cañon to the deepest point f the bed-rock in this basin. Through the tunnel the whole of the alluvium could be sluiced. At least 1,000 inches of water, from all sources, would be at the disposal of the undertakers at all times.

All the mining lands of Moreno are claimed to be on Mr. Maxwell's grant. For a consideration of $1 per month he allows miners to work a gulch claim. Of every lode discovered on his property he claims one-half (1,500 feet) as his share.

The amount of gold extracted from the Moreno Gulch mines from July 1, 1868, to July 1, 1869, exceeds $200,000 in coin.

The fineness of two packages of gold dust, sent by the Moreno Water and Mining Company to the Philadelphia Mint for assay, was .878 in gold and .118 in silver, and .876 in gold and .119 in silver, respectively.

About 500 men were settled at the Moreno Mines in October, 1869.

QUARTZ MINING IN MORENO.

The results obtained hitherto from lode mining on Baldy Mountain and its western foot-hills have been very small, and probably do not exceed a few hundred dollars in the aggregate. Still many large lodes have been discovered, and some of them contain pay-streaks and specimens very rich in gold. A steam stamp mill was set up in Negro Gulch, near Elizabethtown, by Mr. Bartolemew, which did not produce any satisfactory results from the ore crushed by it. The miners generally ascribe this to the bad management and faulty construction of the mill, but it is just as likely that the ores delivered were not sorted carefully enough to be worth crushing. On the whole, very little attention has been paid to quartz mining, principally because the surface of the ground is thickly covered with detritus, which hinders prospecting, and because gulch mining offered quicker returns with less outlay. Of "float" and other indications of veins there is an abundance, and there cannot be any doubt that in a country where so much rough gold is found in the gulches rich quartz lodes must be near by.

CHAPTER LVI.

PINOS ALTOS.

Nearly all the remainder of the gold produced in the Territory during the year, from July 1, 1868, to July 1, 1869, has resulted from the mining operations at Pinos Altos and those at the Old and New Placers. The Pinos Altos mining region is situate in the southwest corner of the Territory, under latitude 33° and longitude 108° west of Greenwich, in the Sierra Madre. It extends north to the Sierra Blanca range of mountains in Arizona, which has not been much explored as yet, on account of the hostility of the Indians inhabiting it, but which is, nevertheless, sufficiently known to make the existence of rich mineral deposits in it an established fact. The minerals represented in the Pinos Altos region comprise almost all the ores containing the most valuable metals, the most prominent of which are gold, silver, copper, lead, and iron. The district is approachable by different routes, one from Fort Craig, being about one hundred miles, the other, from Fort Seldon, being ninety-two miles long. The distance from Santa Fé to Fort Craig is one hundred and seventy-eight, and from Santa Fé to Fort Seldon two hundred and sixty-two miles. Both roads are at present very un-

e, the Apache Indians having lately committed many outrages and
rders along the way.

The following cases may illustrate the perfect control which the red
n has still over that country: During last year the Apaches have
led five mail-carriers and two passengers. They even did not respect
litary escorts. In one instance, I am informed, they attacked and
ve away an escort of ten men; in another, they killed all the passen-
s of the mail coach, one of whom was Colonel Stone, and all the sol-
rs who acted as escort to that coach. This was done near the line of
izona and New Mexico. Scarcely a week passes without Indian out-
ges and depredations in some parts of the Territory, and as long as
Indians are allowed to thus rove over the whole country life will not
safe in any part of New Mexico. Their hostile attitude has, of
urse, greatly delayed immigration and the development of a district
rich in the precious metals that no second can be found in the whole
rritory to equal it.

The history of the district is similar to that of many others in the
est, where the pioneers had not alone to overcome the difficulties
ich the great distances from civilization presented to them, but also
hostility of the savage tribes living in the neighborhood.

In May, 1860, Colonel Snively and a party of Californians discovered
ld in Rich Gulch, near the present site of the town of Pinos Altos.
e news of it spread, and in June of the same year people from Chi-
ahua, Sonora, Texas, and California commenced pouring into the
r Eldorado, so that in December 1,500 had gathered. They worked
placers in different gulches, and are said to have averaged from $10
$15 per day to the hand. In December, 1860, the first quartz lode
s discovered by Mr. Thomas Mastin and a party of prospectors. This
n runs through the mountain which forms the "divide" of the con-
ent, and is the present Pacific Mine.

n the spring of 1861 this mine was bought by Mr. Virgil Mastin, a
ther of the discoverer, and was successfully worked during the year.
e Apaches made several formidable raids during that time on the
ck of the miners, and nearly stripped them of the means to prosecute
ir labors. On the 27th of September a severe battle was fought be-
en the miners and a band of Indians 500 strong, under Mangas Colo-
las and Cachees. The redskins were driven off, but Captain Thomas
stin, who commanded a company of volunteers, was killed, with sev-
l others, in this fight. The impression made on the minds of the
ners was so great that most of them left. A few only remained,
ong them Mr. Virgil Mastin, who could not be induced to leave a
ntry so full of promises of great wealth. Not much was done from
1 to 1864, when a second attempt was made by Mr. Virgil Mastin to
rk the Pacific and several new lodes, the Atlantic, Adriatic, and
ar Creek, which he had discovered in the mean time. The work was
dly commenced when the Apaches again came and took all their
ck from the miners. This caused another suspension of nearly all
ther labors until 1866, when Mr. Virgil Mastin, S. J. Jones, Joseph
ynolds, J. Edgar Griggs, and J. Amberg, organized a company, un-
the name and style of "The Pinos Altos Mining Company," under
harter granted by the legislature of New Mexico. From this time
dates a better era for the Pinos Altos districts, so that now 213
rtz lodes are recorded in Pinos Altos, and 57 in Central City district.

Quartz lodes recorded in Pinos Altos up to September 19, 1869.

No.	Name of lode.
1	A No. 1.
2	Hermosura.
3	Comet.
4	Nolea.
5	Harry Cuy.
6	Montezuma.
7	Inca.
8	Accidental.
9	Boomerang.
10	Bear Creek.
11	Accidental, extension.
12	Aztec.
13	Arizona.
14	Langston, silver.
15	Langston, extension, gold.
16	Deer.
17	Union.
18	Indigo.
19	Summit.
20	Langston, extension, silver.
21	Pacific No. 1.
22	Pacific No. 2.
23	Langston, silver, extension.
24	Pacific No. 2., extension.
25	Empire State.
26	Ætna.
27	Bobtail.
28	Plata y Plomo.
29	Anderson & Winterburn.
30	Tompkins.
31	Plata y Plomo, extension.
32	Ottoma.
33	Aztec, extension.
34	Arizona, extension.
35	Forest Tree, extension.
36	Empire State, extension.
37	Eastern.
38	Jaeger.
39	Commercial.
40	Royal.
41	Hunkey.
42	Quien Sabe.
43	Santa Clara.
44	St Lawrence.
45	Grass Valley.
46	Washington.
47	Enterprise.
48	Grass Valley, extension.
49	Arizona, extension.
50	Quincy.
51	La Esperanza.
52	La Esperanza, extension.
53	Arizona, extension.
54	Arizona, extension.
55	Oh No I Guess Not.
56	Twin Sisters.
57	Aztec, extension.
58	Arizona, extension.
59	Arizona, extension.
60	Pride of the West.
61	Arizona, extension.
62	Olive Branch.
63	Olive Branch, extension.
64	Olive Branch, extension.
65	Game Cock.
66	St. Lawrence, extension.
67	Game Cock, extension.
68	Olive Branch, extension.
69	Olive Branch, extension.
70	Montgomery, copper.
71	Three Pinos, copper.
72	Olive Branch, extension.
73	Arizona, extension.
74	Davis.
75	Davis, extension.
76	Aztec, extension.
77	Davis, extension.
78	Mountaineer.
79	Bellerophon.
80	Knickerbocker.
81	Goldfinch.
82	Eureka.
83	Mountaineer, extensino.
84	A No. 1, extension.
85	German.
86	Olive.
87	Jaeger, extension.
88	Aztec, extension.
89	California.
90	Aztec, extension.
91	California, extension.
92	Missouri.
93	The Orphan.
94	Hermosura, extension.
95	La Esperanza, extension.
96	Olive, extension.
97	Maine.
98	Apache.
99	Arizona, extension.
100	Plata y Plomo, No. 2.
101	Arizona, extension.
102	El Dorado.
103	Montezuma, extension.
104	Boomerang.
105	Coyote.
106	Asiatic.
107	Granite State.
108	Broadside.
109	Turkey Gulch.
110	California, extension.
111	Turkey Gulch, extension.
112	Azuc.
113	Ringgold.
114	Bear Creek, extension,
115	Langston, extension.
116	Langston, extension.
117	Langston, extension.
118	Montezuma, No. 1.
119	Montezuma, No. 2.
120	Montezuma. No. 3.
121	Buckeye.
122	Montezuma, No. 4.
123	Boomerang, extension.
124	Ringgold, extension.
125	Union, extension.
126	Desideria.
127	Indigo, extension.
128	Desideria, extension.
129	Summit, extension.
130	Arizona, extension.
131	Nyantic.
132	Mountaineer, extension.
133	The All O. K.
134	Quien Sabe, extension.
135	Cross Cut.
136	Plata y Plomo, extension.
137	Saleo.
138	Saleo, extension.
139	Excelsior.
140	Mamoneld.
141	Hume.
142	Variety.
143	Plomoro.
144	Continental, extension.
145	Buckeye, extension.
146	Homestead.
147	Forest Tree, silver.
148	Forest Tree, silver, extension.
149	Forest Treo silver, extension.
150	Mechanic.
151	Lone Load.
152	Lone Load, extension.
153	Homestake.
154	Homestake, extension.
155	Homestake, extension.
156	Last Chance.
157	Last Chance, extension.
158	Champion.
159	Rich Gulch.
160	Rich Gulch, extension.
161	Grierson.
162	Keystone.
163	Missouri, extension.
164	Santo Domingo.
165	Santo Domingo, extension, silver.
166	Chihuahua.
167	Golden Arrow.
168	Rough and Ready.
169	Golden Arrow, extension.
170	Continental, extension.
171	Whisky Creek.
172	Pass Over.
173	Kansas.
174	Iowa.
175	Iowa, extension.
176	Grecian.
177	Grecian, extension.
178	Mineral Point.
179	Eureka, extension.
180	Flag of our Union.
181	Eureka, extension.
182	Asiatic, extension.
183	Arizona, extension.
184	Mechanic, extension.
185	Boca Leva.
186	Evening Star.
187	Pacific.
188	Quincy, extension.
189	Arizona, extension.
190	Arizona, extension.
191	Arizona, extension.
192	Arizona, extension.
193	Volair.
194	Duncan.
195	Non Plus Ultra.
196	Chandler.
197	Langston, extension.
198	Twin Sister, extension.
199	Wide West.
200	Pride of the West, extension.
201	Olive Branch, extension.
202	Last Chance, extension.
203	Arizona, extension.
204	Optic.
205	Pacific No. 2, extension.
206	Pacific No. 2, extension.
207	Texas.
208	Australia.
209	Last Chance, extension.
210	Asiatic, extension.
211	The Lucky Strike.
212	Enterprise, extension.
213	Langston, extension.

J. B. WOODS, *Recorder.*

PINOS ALTOS, N. M., *September* 19, 1869.

Quartz lodes recorded in Central City up to September 19, 1869.

Name of lode.	No.	Name of lode.	No.	Name of lode.
New Mexican.	22	San José, silver.	43	Stewart.
Owena.	23	North Star.	44	Granite State.
Humboldt.	24	California.	45	McKnight.
Corbin.	25	Eagle.	46	Golden Fleece.
Chimio.	26	Old Jesuit.	47	Iturbide.
Stapp.	27	Wild Swan.	48	Summit.
Chavez.	28	The Main Key.	49	Pine.
Sedillor.	29	Quigley.	50	Cedar.
Wanbonsa.	30	O. K.	51	Great Expectation.
Desideria.	31	McMorries.	52	Consolidation, quicksilver.
Stella.	32	Stonewall.	53	Consolidation, extension, quicksilver.
Virginia.	33	Dunward.		
Compromise.	34	San José, copper mine.	54	Consolidation, extension, quicksilver.
Medora.	35	Santa Rita, copper mine.		
Lincoln.	36	Maltea.	55	Consolidation, extension, quicksilver.
Hanover.	37	Massic.		
Chimayo.	38	Gold Tree.	56	Consolidation, extension, quicksilver.
Fort Bayard.	39	Central City.		
Blanchard.	40	Poor Man's.	57	The Star of Hope.
Old Antiquity.	41	Union.		
Montezuma.	42	Fielding.		

CHAS. KEERL.

ort Bayard, N. M., *September* 20, 1869.

PINOS ALTOS MINING DISTRICT.

The Pinos Altos mining region resembles very much that near Cen- l City, Colorado, as far as the nature of the lodes and the character the ores are concerned. Ores from this district may be easily mis- ken for Colorado ores; they are composed of the same decomposed n-stained quartz, near the surface, and contain, like the Central City s, free gold, sulphurets of iron and copper, auriferous and argentifer- s galena and zincblende lower down. After a short-lived prosperity, ile working the decomposed surface ores, the rebellious character of minerals in the lower levels and the want of the proper capital, to- her with the dread of the savages, have again discouraged the ners, so that nothing but the remnants of better times are now to be n at Pinos Altos. The town itself contains about 200 houses, one lf of which are empty. It differs exceedingly from other American ns, and not to its advantage. Mr. Sturemburg, assayer at Santa Fé, ited the place in the latter part of 1868, and says: "Here you do t find the busy life and hum and bustle; here you do not see the eets lined with stores, bar-rooms, and gambling saloons; here you not hear every day of some new rich discovery; here you do not et the sturdy miner, coming loaded with yellow dust, to spend some, not all, of his earnings. If it were not for the rattling of the Pinos tos Mining Company's quartz mill, built in the center of the town, thing characteristic of a mining place could be found here. Saturday ening or Sunday morning the few gulch-miners, trying in vain to ke their "pile" in these mountains, bring in the scanty earnings of e week, barely sufficient to procure a new supply of the most neces- ry "grub." The mill and mine hands are paid very irregularly, green- cks being a scarce article with the companies; and the natural con- quence is, that this place is a very orderly and sober one. None of e drawbacks of other mining towns are known here; no noisy dancing gambling saloons; no fighting or shooting of men under the influence liquor. At eight o'clock at night this place looks as dead asleep as y farming country village. It would certainly be very desirable if our prosperous mining camps could follow such a commendable example; but according to our customary reasoning such a state cannot help but impress the idea upon our mind that this is not a prosperous mining region, and that conclusion is quite correct. On the other hand, it is very wrong if the new comer, finding himself disappointed in his sanguine expectations, puts the fault upon the mines. This is, it is true, not a mining region like California was in its early days; fortunes cannot be made here as easily; the gulch diggings are scanty, and many of them worked out, and, above all, water is very scarce. To work the quartz mines to advantage capital and skill are required, and neither i to be found here."

Three mining companies have been incorporated at Pinos Altos: *Th Arizona*, already broken down and dissolved, although their mines wer very good; the *Bay State*, a wild-cat concern, the mines of which ma possibly be in the moon, and the *Pinos Altos Mining Company.* Th latter is the only one now in existence. It owns rich mines, and ough to be in a flourishing condition, especially as the shareholders are mostl rich men. But the management is unsuccessful. The really rich ore i wasted and barely pays expenses, furnishing another pretext for peopl to condemn the mines, when the fault lies with the parties who operat and control them.

The Arizona ledge was formerly the property of the company of th same name, but is now held by one of its creditors. The vein is irregular, has unreliable wall-rocks, and a width of from four to twenty inche It has produced heretofore very rich decomposed ores, assaying from $180 to $300 per ton. Lower down, auriferous pyrites, which nobody understands how to work here, occupy the vein.

The Langston ledge, another vein belonging to the Arizona company is more regular, and has a width of from eight to fourteen inches. I carries streaks of very rich gold ore, worth from $2 to $6 per pound Besides this, it contains what is here called silver ore, an antimonia lead and zinc ore, which seldom shows more than a faint trace of silve

The Pacific ledge, belonging to the Pinos Altos Mining Company, i an irregular and broken vein, running through the dividing ridge of th continent. It carries in pockets and chimneys very rich decompose gold quartz, assaying from $150 to $500 per ton. In other parts th vein is more solid, and carries carbonates of copper and iron pyrites i very hard but poor quartz, which contains also some of the so-called si ver ore. The mine is opened by a tunnel of over seven hundred feet i length and air-shafts. The ledge, above the tunnel, about one hundre and twenty feet deep, is mostly worked out.

The Aztec ledge is the extension of the foregoing, and has the sam appearance. It has been opened lately.

The Atlantic ledge, owned by the Pinos Altos Mining Company, is n worked, though it is apparently the best mine in the neighborhoo The deepest shaft is sunk only forty feet, and shows a regular ledge from three to five feet in width, containing decomposed quartz onl Some of this ore runs as high as $1,000 per ton, and it is really a grea pity that such a good vein is allowed to lie idle.

The Rafael ledge carries sulphuret of lead, containing $20 to $30 silver per ton. Much money has been wasted in this mine. Two shaf were sunk, the deepest of which measures about one hundred and fift feet, but the ore not improving so much as the owners were foolis enough to expect at that depth, they became discouraged and ceas working. The shafts are now full of water. The mine can easily drained by a tunnel, and will, in time, prove valuable.

Besides the above, several good veins of silver-bearing galena have een opened, but none of them are worked at present. For some time e smelting process in Mexican adobe furnaces was tried, but proved a ilure, as might have been expected. The company which undertook e experiment lost some $50,000 by it, and has nothing left but a mass f adobe ruins. Smelting operations will, however, form a considerable art of the beneficiating operations in this region at some future time, s the conditions for carrying them out profitably are very inviting. he district contains an abundance of good fuel, consisting of oak, ash, dar, and walnut. The pine is large, of superior quality, and will anwer for an excellent building material. Good indications of coal are und near the head-waters of the Gila River, at the base of the mounin range; fire-proof material, for the construction of smelting furaces, is also found near by.

The town of Pinos Altos is situate over five thousand feet above the a level. In the center of the town the mill of the Pinos Altos Mining ompany is situated. It has fifteen stamps, weighing seven hundred ounds each, and is driven by an eighteen horse-power engine. The ompany have also a circular saw-mill attached, which supplies the town ith good lumber at from $30 to $50 per thousand. The mill is built n a dry arroyo or ravine; the necessary water is gathered from the ed-rock by means of drains centering in a cistern, and is raised to the atteries by pumps. The sluices empty into large settling tanks, for e purpose of saving the tailings as well as the water, which passes om here into the cistern to be used over and over again. It gets very pure in this way, and at times is so scarce as to prevent the running the mill. Frequent repairs of the mill, which become necessary at ort intervals, limit the actual working time still more, and it is calcuted that the three five-stamp batteries perform on an average the work one battery during fifteen days each month. About eight hundred to e thousand tons of ore are crushed per annum, yielding from $30,000 $40,000.

The Amberg mill, situate on Bear Creek, is better supplied with water. is a six-stamp mill, works about one-fourth of the time, and crushes om four to five hundred tons, yielding $15,000 to $20,000 per annum.

The Ryerson mill, also situate on Bear Creek, is a fine ten-stamp mill, ilt in San Francisco, California. It is used principally for custom rk, and has been run with varied success for prospecting purposes different parties during last year. It has been either rented for $125 r week, or the owners crushed the ore themselves at $10 per ton. Not ore than three months out of the twelve it has thus been in operation, oducing during that time from $15,000 to $20,000. A small quantity gold, from $8,000 to $10,000, has been taken from arrastras, making e total amount of gold produced from quartz in the Pinos Altos disict, $60,000 to $70,000 during the year.

The *placer mines* have yielded during the same time about $100,000. hey have paid from $2 to $10 per hand daily, and occasionally as high s $150.

The bullion produced by the stamp-mill process (using amalgamated pper plates) is often of very low fineness, as it contains much silver. is worth only about $15, currency, per ounce. The gulch gold is worth 20 per ounce.

The number of people inhabiting the district at present is estimated t six to eight hundred.

Advices as late as October, 1869, inform me that the Pinos Altos Ming Company, the principal organization at Pinos Altos, have suspended operations, for reasons unknown to the public. The gulches were not worked then for want of water. The Atlantic lode had lately paid $45, the German lode $25 per ton. But very little mining was carried on, notwithstanding the richness of the ores, for want of capital and skill in reducing the ores.

The following assays of ores from the Pinos Altos mining district were made by Mr. Sturemburg, and may here find a place:

Montezuma ledge: Argentiferous galene, from 42 feet below the surface. Silver, per ton, $72 58.

Rafael ledge: Argentiferous galena, from 130 feet below the surface. Silver, per ton, $65 70.

Arizona ledge: Decomposed quartz from 120 feet below surface. Gold, per ton, $264 52.

Atlantic ledge: Decomposed quartz from 30 feet below the surface. Gold, per ton, $93 25; selected specimen from same vein, $276.

Langston ledge: Ore from 100 feet below the surface, carrying sulphurets of zinc, iron, and lead. Silver, per ton, $32 61; gold, per ton, trace. From the same vein, in a narrow streak of decomposed ore: gold, per ton, $105 10. From the same vein, about 30 feet from the surface, from a streak of decomposed quartz, of about 2½ inches in width: gold $7,465.

Pacific ledge: From tunnel 110 feet below the surface; iron pyrites; gold, per ton, $32 20; decomposed quartz, gold, per ton, $64 53; decomposed quartz, silver, per ton, $6 22; copper ore, silver, per ton, $23 50; same vein, decomposed quartz, from a narrow irregular streak in the western part of the mine; gold, per ton, $264 08.

Aztec ledge, eastern extension of the Pacific ledge, from 45 feet below the surface, irregular and narrow streaks of decomposed quartz: gold, per ton, $37 63.

CENTRAL CITY DISTRICT.

This district lies in the neighborhood of Fort Bayard, about eight miles east of Pinos Altos proper. The most prominent mines are the Hanover, Santa Rita, and San José copper mines, carrying both gold and silver in their ores, and the Stewart ledge, a gold vein in the immediate vicinity of Fort Bayard.

The *Hanover* mines, ninety miles distant from Fort Craig, and seven miles north of Fort Bayard, are situate about 6,350 feet above the ocean, on a mountain, where a scenitic granite has elevated the carboniferous limestone 200 feet up its west flank. Most of the openings, however, are near where the first aqueous rocks appear in the narrow valley, in which also the furnace is located. The granitic range strikes northwest and southeast, and uplifting the limestone gives it on the west flank a southwest dip. This axis, according to Professor R. E. Owen, is crossed by a highly ferruginous rock, sometimes a pure magnetic iron ore, trending apparently rather in dyke form northeast and southwest, and forming frequently with the adjacent aqueous rocks immense masses of breccia for a considerable distance. Near these disturbed portions shafts have been sunk and several tunnels driven, which exposed extensive deposits of copper ores. There is no proper vein; the ore occurs as carbonate, gray sulphuret, and red oxide, and considerable native copper is found in sheets and lumps. The former contain both gold and silver. They occur ramifying, sometimes in a width of 50 or 60 feet, through the decomposed felspathic rock, and often form rich deposits, which extend vertically below any point yet reached.

The mine has produced, from 1858 to the spring of 1861, about one milion pounds of metallic copper. The first smelting was done in a high-blast furnace, and the refining in a reverberatory. Copper of an excellent quality was produced, which commanded a price in the market equal to the best Russian copper. The cost of extracting the ore from the mines and smelting was ten cents per pound; it sold at New York for twenty-three cents.. Before the war the copper was shipped in pigs of one hundred to one hundred and twenty pounds, by mule wagons via Mesilla to Port Lavacca, Texas, at a cost of six cents per pound. From Lavacca schooners took it to New York for $5 per ton. In the time of the late war, the confederate forces invaded this country from Texas, confiscated all the machinery and everything else belonging to the mine, including 187,000 pounds of copper, which they took to San Antonio. It is reported that the ore out of which this copper was made averaged fifty-eight per cent. The Texans, while on this expedition, are said to have killed every Indian they came across, and since that time the Apaches are more hostile than ever.

The Hanover mine is one of the most valuable in the Territory of New Mexico. Unfortunately it is not worked at present, though its owners are all rich men and could easily afford to invest the $50,000 necessary to start operations again. But being ignorant of the real value of their property, they hesitate to invest the necessary capital.

The Santa Rita mines, situated about five miles east of Fort Bayard, in Grant County, township 17 south, range 12 west, at an elevation of about 5,800 feet above the sea, are claimed at present by the Santa Rita Mining Association, who have had the property surveyed by the United States mineral surveyor for New Mexico, and applied for a patent. They are situated on the same belt as the foregoing, a few miles south of it, and show similar characteristics. Worked by Spaniards and Mexicans for many years, their history is quite an interesting one and may find here a place.

This deposit was first discovered near the close of the last century. The Indians showed it to Lieutenant Colonel Manuel Carasco, and gave him the right to work it. Carasco sold his right to Don Francisco de Alquea, who commenced work upon the mine in 1804, and continued until his death, which occurred in 1809. It was then worked by a man named Ori, under permission from the widow of de Alquea. Up to 1826, it was worked by different parties, who left no statistics as to the amount of ore taken out by them. From 1826 to 1834 it was in possession of Robert McKnight, who, it is said, realized a large amount of money from the mine during that period. After a short abandonment, on account of the hostilities of the Indians, it was taken possession of by Siqueiros, who continued to work it until 1860, when he sold his interest to Sweet and La Coste, who worked the mine until 1862. At this time the country was invaded by the confederates, and this mine, as well as a number of others in New Mexico, was abandoned. The mine has been worked to a depth of nearly two hundred feet, and the lower levels are now filled with water and many of the galleries caved in.

The ores are, as in the Hanover, principally red oxide and carbonate of copper, which were smelted, together with the virgin copper occurring in sheets in the feldspathic porphyry, in a low Mexican blast furnace. At present the Santa Rita mine is worked by Messrs. Sweet, La Coste, Brand, and Fresh. They have in their employ twenty-five to thirty miners, mostly Mexicans from Chihuahua, to whom they pay $2 per day. They run a small Mexican blast furnace, which has yielded 12,000 pounds of metallic copper during the last eight months. The metal was shipped by way of Sheridan, the terminus of the Kansas Pacific railroad, to Pittsburg and other markets. The freight was about eight cents per pound. Return freight from Fort Union to Sheridan is one and a half cents, from Santa Fé to Sheridan two and a half cents, and from Sheridan to New York, by the carload, about two cents.

The ore of the Santa Rita contains a small proportion of silver.

It is highly probable that an abundance of good copper ore can be found, not alone along the entire distance between the Hanover and Santa Rita mines, but also in some of the parallel ridges.

In the southwestern prolongation of the Santa Rita range, and about one hundred and fifty feet lower, the *San José* mines are met with. They show an abundance of malachite and azurite, chiefly in those places where quartz veins, striking east of north, cut through the porphyritic range bearing northwest. The mine has formerly been profitably worked, but is now entirely abandoned.

In the immediate vicinity of Fort Bayard three or four good veins have been discovered, the best of which is the *Stuart ledge*. It is two to three feet wide and carries gold in decomposed quartz, which assays $120 to $150 in gold. The mine is not worked at present, for want of the proper machinery. The owners would be very willing to have it worked by others on shares.

CHAPTER LVII.

THE OLD AND NEW PLACER MOUNTAINS.

The placer mines at the Old and New Placer Mountains, near the towns of Real de Dolores and Real del Tuerto, are considered the richest in the Territory of New Mexico. Thousands of Mexican miners have been employed here in former times washing gold in the most primitive manner. Mining was then mostly done in the winter time. The men would dig holes in the drift at the foot of the mountains, pack the gravel out of these holes on their backs, and wash the gold out in wooden batias, (dishes of about eighteen inches in diameter,) with water procured by melting the snow in round holes with heated stones. Even at the present time it pays some Mexicans to transport the gravel on donkeys to the nearest creek and to wash out the gold. In this crude manner they have taken out millions of dollars' worth of gold. When the United States took possession of New Mexico most of the Mexican miners left for Chihuahua; a few only remained, and have subsisted by gold-washing ever since. They make a practice of running in great haste to the placers after every rain-storm, in order to wash gold and to collect such nuggets as may have been exposed by the currents of rain-water. On such an occasion a nugget worth $1,200 has been found. The scarcity of water has thus far prevented American miners from carrying on gulch mining in these localities, but there is no doubt that many millions of gold can be extracted here as soon as a sufficient supply of water is brought to the placers. Surveys have established the practicability of constructing a ditch to be fed by the Pecos River. As the soil is mostly sandy, the water ought to be brought for most of the distance in clay pipes, which can be made at a very small expense by the Pueblo Indians. In this connection the failure of the Moreno ditch during last year ought to teach a lesson for future enterprises of this kind. Mr. William Kronig, an enterprising citizen of New Mexico, has of late exhorted his fellow-citizens to take this enterprise in hand. He says that all the work on this ditch, except the first ten miles, can be carried on in winter time, as the climate is sufficiently moderate for such an undertaking; that two natural basins on the line of the ditch could be used as reservoirs for the collection of the night and Sunday water, and that the locality offers, in general, a great many advantages which the great undertaking at Moreno had not. He insists that by reviving the placer mining at the Placer Mountains the Territory and its inhabitants would derive a greater benefit from their energy bestowed on that enterprise than they could from any other mining operations in New Mexico, not alone on account of the known richness of the locality, but also because that locality is nearly in the middle of the Territory, so that everything going to and coming from the placers would have to traverse some two hundred miles on either side, thus benefiting all parts equally.

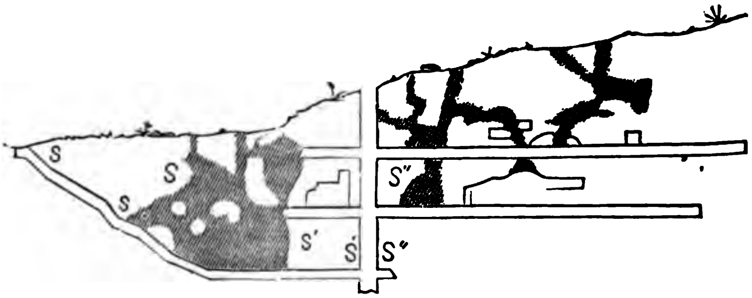
The principal placers of *Real de Dolores* are situated at the mesa, on which the church is built, in the gulch of the reals Cunningham Arroyo and Arroyo Viejo. Near the town of Real del Tuerto the so-called Bonanza is the principal gold-bearing locality. The gulches of the Old Placer empty into Galisteo, those of the New Placer into Tuerto Creek, both of which are affluents of the Rio Grande del Norte. There are a great many gulches in both localities; all of them are narrow, steep, and shallow. At the foot of the mountains the bed-rock lies from twenty to forty feet below the surface, and the drift above it contains three different strata of rich gravel. Hydraulics will undoubtedly furnish large returns in such a locality as soon as water is brought here from the Pecos.

The gold of these placers has been easily traced to the lodes it originated from. Very few of these, however, have been worked formerly near the surface by Mexicans, who used to carry the ore on donkeys to their arrastras at Tuerto and San Pedro. Since the Mexican miners left, a few Americans took possession, covering the two mountains by very large grants, and from that time on the progress made in the development of the mines is in nowise commensurate with their known richness. The companies holding the grants have opened the mines to a very limited extent—entirely insufficient for a supply of their stamp-mills. By erecting machinery before they even knew anything about the grade or sufficiency of their ores they have wasted their capital in the same manner as hundreds have done in other localities, and now they are actually without funds to make good what they have formerly neglected. Thus misdirected capital and energy and want of professional skill and foresight have prevented, so far, the proper development of these really good mines. And this is not the only obstacle to the progress of the country. The very fact that these gold-bearing mountains are owned, in large tracts, by only a few companies, under Mexican land grants—by associations which most of the time do not work themselves, yet prevent others from prospecting, even—this very fact prevents, more than anything else, such rapid progress in the development of the mineral resources as we have seen in all the northwestern States and Territories. New Mexico is full of such grants, most of which are not even surveyed, so that the pioneer who comes here to take up a homestead for himself is never certain whether he can retain the fruits of his hard labor.

The following mines were visited and surveyed at the Old and New Placer Mountains:

The Cunningham mine, in Cunningham gulch, near Real de Dolores: **The croppings of this vein are** over 200 yards wide, and can be traced **over three mountains.** They consist of quartz and feldspar and contain **rich seams of free gold,** together with products of decomposition of iron pyrites. The hanging wall consists of syenite, the foot wall of a dike of porphyry. There is a surface cut and an inclined shaft 40 feet deep (formerly concealed by the Mexicans) at the point of intersection of the lode, here 15 feet wide, striking north 78° east and dipping 80° south, and a rich seam, about 2 feet wide, which courses north 23° east and dips 70° northwest.

The Ortiz mine. This mine is situate on the southeast side of Gold Mountain, (Sierra del Oro.) The vein strikes north 13° east, dips 75° northwest, and is encased in syenite. Its croppings consist of iron stained quartz and feldspar. The surface ore paid well to a depth of 80 feet; then a lean streak was met with, and at the depth of about 180 feet undecomposed sulphurets of iron and copper made their appearance. The main shaft is worked by a horse whim; it is 180 feet deep and 3 drifts, 60 feet apart from each other, are run from it on the vein. A tramway leads from the shaft to the New Mexico Mining Company's forty-stamp mill. Twenty stamps were recently finished, and the frame for twenty additional ones is erected. About 3,000 tons of ore are on the dump near the shaft. The first level running north from the shaft is 60 feet below the surface, 475 feet long, and rather crooked. The second level, 120 feet below the surface, runs north of the shaft for 240 feet and 120 feet south of it. The third level, 180 feet below the surface, extends 100 feet to the south and connects with an incline 300 feet deep. The lode is here 5 feet wide and is encased in good walls. The richest ore was taken out 60 feet north of the main shaft and 60 feet from the surface; very good ore was also found at a depth of 120 feet and 130 feet south of the main shaft. The subjoined section of the mine, taken on the plane of the vein, will give a very good idea of the work done so far:



ORTIZ MINE, Old Placer Mountains, New Mexico.—Scale, 200 feet to the inch.

North is on the left hand of the sketch. S S, S' S', S'' S'', are parts of the vein containing pyrites. The workings shaded are those of the old Mexican proprietors. Later stopes have been outlined but not shaded. The main shaft, the long levels to the south, and the irregular incline on the north are later than the old Mexican excavations. The Ortiz shaft is the first opening into these latter, north of the main shaft.

The *Brehm* lode is worked by the New Mexico Mining Company, Colonel Anderson, superintendent. They have sunk three shafts, the second 865 feet distant from the first, and the third 450 feet from the cond. No. 1 shaft is 31 feet deep, and a drift 20 feet long is run from t toward the east. The ledge is here 2 feet wide, strikes north 78° ast, and dips 75° south.

No. 2, northeast from the first, is 40 feet deep and shows the vein to e of the same width as in No. 1.

No. 3 is 88 feet deep. The lode dips here 50° south. The ore in all he shafts is iron-stained quartz, and prospects well in parts of the vein.

Many lodes have been discovered besides the above, but they are not opened.

The new mill has only recently started, and for that reason and the great drought during the season the whole product from both the old and new placers, during last year, does probably not reach quite $10,000. $45 per month has been paid to Mexican miners; anthracite coal costs $5 per ton, at the mill; wood, $2 25 per cord; lumber, $25 per thousand feet at the saw-mill, and $40 delivered at the mines. The present population of the district of Real de Dolores is about 150 souls.

The principal mines worked during the last year at Real del Tuerto are the Candelaria and Hutchinson, on the south side of Old Placer Mountains, and the Ramirez and Brown, at the Tuerto Mountains. A stamp-mill (10 stamps of 525 pounds each, dropping 10 inches and 36 times per minute, driven by a 20 horse-power engine) has been erected lately, which has crushed ore from the Ramirez and Candelaria lodes with satisfactory results. This mill was sold a short time ago to the parties who work the *Candelaria*. On this lode they have started two tunnels, one 12 feet below the other. The vein strikes in this locality north 7° east, and dips west; at the breast of the upper tunnel, 30 feet in, the vein is faulted by a cross vein of kaoline, 1 foot wide, which courses orth 33° east. Further north, toward the top of the hill, the lode has ormerly been worked by an open cut, bearing north 23° east. It is 150 eet long, and at the deepest part the excavation is 64 feet in depth. rom this locality rich ore has been extracted, which yielded good reurns by mill process. In its southwest part the lode bears north 18° ast, and dips 80° west. The tunnels are started about 150 feet below he old workings.

The *Hutchinson* mine, situated on the same side of the mountain, prospects well, but no quartz has been crushed as yet. The ore consists of granular, iron-stained quartz, containing garnets and malachite. Several other lodes on the same hill contain the same kind of ore.

The most remarkable mine on Tuerto Mountains is the *Ramirez*. The ode is 25 feet wide, and carries decomposed iron-stained quartz and malachite, with free gold. In former times it has been worked by the Mexicans, who dug four large caves into it, leaving pillars for support. Mr. George Brown has opened the lode lately by an open cut about 50 feet long and 25 feet deep. The vein forms a very regular stratum of brown and green color between parallel and well-defined walls. It lies nearly horizontal, its dip being only 10 degrees to the southwest, (into the hill.) Six average samples, taken from different parts of the vein, prospected well, yielding from $10 to $20 to the ton. In another locality, about 500 feet from the opening just mentioned, the lode has been exposed by stripping it of the surface soil. It shows transparent and partly crystallized quartz, with malachite and copper pyrites. An attempt was made to smelt this ore in a little adobe furnace near by, which proved, of course, a failure, as the ores had not been dressed.

The *Brown* lode, recently discovered, has a course of north 89° east, and dips 80° south. It has good walls, and the shaft, now 35 feet deep, shows two seams of brown, ferruginous quartz, with free gold visible to the naked eye. One of these seams is 5 inches, and the other 3 feet wide. No ore has as yet been worked at the mill.

Another very promising lode on Tuerto Mountains, which prospects very well, is the *Humboldt* 100*th*, so called in honor of Humboldt's centennials.

CHAPTER LVIII.

MISCELLANEOUS.

Indications of placer gold are very general all over New Mexico, and I believe that with the introduction of hydraulics this interest will become a very prominent one in the future. Color can be found almost anywhere in those regions where the older rocks are the underlying formation or where they are adjacent to the gulches. Even in the very city of Santa Fé color can be got.

The *Sierra Blanca mining district* is a district but lately discovered and organized. It lies in the county of Lincoln, and embraces the Sierras Blanca, Carrizo, Patos, and Jicarilla. It embraces between three and four hundred square miles. In and around these mountains are the ruins of a large number of ancient towns, the reliable history of which, as well as that of their inhabitants, is unknown. The traditions of the Mexicans and Indians say that these towns were inhabited by a people who worked mines for precious metals in these mountains, and some late discoveries do indeed point to such. Situated in a portion of the Territory which until recently was but little known and within the range of the Apaches, these mountains were looked upon by the prospector as an Eldorado, which could only be reached by the concerted action of a number of men.

During the past summer a party spent a few weeks prospecting in this district. They found a number of good placers and numerous lodes of gold-bearing quartz. One of the gulches discovered, the Nogal, is now worked and yields from $8 to $10 per hand, daily, with only a small sluice head of water. The placers generally lie in patches along the side of the mountains, and the dirt will, in many places, pay carting to the water for washing. In the Jicarilla Mountains is a large amount of dirt which prospects well. Prior to 1861 mines were worked here by the Mexicans, who had to cart the dirt from one direction and water from another. Still they took out a large amount of gold and made a paying business of it; but at the present time the difference between free labor and the peon labor of that time would swallow the profits. The only lodes which have been in any way developed are the Nogal and Sierra Blanca. The former lies in a bench of the White Mountains, between the Nogal and Tartelita Creeks, and about three-quarters of a mile from either. The vein matter, at a depth of 15 feet from the surface, is 6 feet wide, and consists of blue talcose rock with narrow seams of quartz running through it. The latter contain iron pyrites and free gold. Both walls are syenite, the hanging wall firm, the foot-wall soft and partly decomposed. An assay from an average sample showed $79 gold per ton. This lode is admirably situated for working. Water from the Nogal Creek can be brought directly over the lode by means of a ditch two miles in length.

The *Sierra Blanca lode* lies seven miles distant from the Nogal in a southwesterly direction, and was discovered by the convergency of the lodes in the benches, which all seemed to point to this vein. Its outcrop is found on the summit of a high ridge between the Rio Bonito and Nogal Creek, and shows a width of 30 feet. It is a white calcareous rock, and assays between $40 and $50 per ton. The quantity of this ore appears to be inexhaustible.

Many other lodes will undoubtedly be found in these mountains, as soon as they are more thoroughly prospected; the indications of gold, silver, and copper ores are very abundant. In the Cañon del Agua, Sierra de la Madalena, sixteen miles west of Socorro, on the Rio Grande, a new gold bearing locality was discovered during last summer. Sinking a shaft to the bed rock, the prospectors found, immediately overlying it, a stratum of yellow, heavy dirt, which contained no gold whatever. Above this yellow dirt a black layer prospected sixteen "colors" to the pan; the next stratum above gave four, the following five, and one still higher up six "colors" to the pan, while the surface dirt showed in one pan two, and in another one "color." In several other localities from five to fifteen "colors" per pan were found in the surface dirt. Although all this was quite encouraging, and furthermore a plentiful supply of water could be had in the Cañon del Agua during the entire year, work was not continued on account of the limited means of the party at work.

Not less interesting districts are those of Arroyo Hondo near Taos and Embuda, Picuries, &c., between Taos and Santa Fé, and the almost unprospected western slope of the Rocky Mountains, between Sangre de Christo Pass near the southern boundary line of Colorado and Santa Fé. The valley of Taos is the principal agricultural district in New Mexico; labor and provisions are very cheap here, and this circumstance will greatly facilitate the reopening of mines in this neighborhood. Taos has been a mining district in former times, until 1680, the year in which the revolt of the Pueblo Indians against their Spanish oppressors took place. At that time the Jesuits, who were then the principal miners, and who used the Pueblo Indians as slaves in their mines, were massacred. Mr. Gregg says in relation to this, "Tradition speaks of numerous productive mines having been in operation in New Mexico before the expulsion of the Spaniards in 1680. But the Indians, seeing that the cupidity of the conquerors had been the cause of their former oppressions, determined to conceal all the mines by filling them up and obliterating as much as possible every trace of them. This, it is told, was done so effectually, that after the second conquest (the Spaniards not having turned their attention to mining pursuits in the meantime) the succeeding generations were unable to discover them again. Indeed, it is now generally credited by the Spanish population, that the Pueblo Indians up to the present day are acquainted with the "locales" of a great number of these wonderful mines, of which they most sedulously preserve the secret.

"It is not at all probable, however, that the aborigines possess a tenth part of the knowledge of these ancient fountains of wealth that is generally attributed to them; but, that many valuable mines were once wrought in this province, not only tradition, but authenticated records and existing relics sufficiently prove. In every quarter of the Territory there are still to be seen vestiges of ancient excavations, and in some places ruins of considerable towns, evidently reared for mining purposes."

Thus far, Mr. Gregg. Tradition, in a country like this has, of course, many wonderful and extravagant tales to tell. Thus, in the Taos Valley, and at the mines of Arroyo Hondo, the story goes, and finds the most earnest believers, that a Mexican, by the name of Vigil, found in an old church at Guadelajara, Mexico, a document, in which it was stated that the Spaniards had worked mines in the Taos (Pueblo) Mountains for silver; that they took out millions, and had fourteen millions on hand at the time of the massacre, (1680,) which they concealed in a shaft. The paper stated that these silver mines were situated on the southwestern slope of the Pueblo Mountains. A similar story, giving fourteen millions, is told about Gran Quivira, near Fort Stanton. The former statement is corroborated by recent experience, as far as the existence of silver bearing ores in these mountains is concerned. Some specimens from a vein at the head of Red River, between Moreno and Taos, were brought to Santa Fé by a Swedish miner, Gus Lawson. They contained quartz, galena, and zincblende, and they were found to contain $120 silver per ton and a trace of gold. The lode from which these specimens were taken is owned by three Swedes, Lawson, Olsen, and Petersen, and named "Star of New Mexico." Another sample of galena, brought by Mr. Knapp from the same neighborhood, yielded $30 08 silver, and $15 gold, per ton. As there is an abundance of wood, water, and grass in these mountains, and hostile Indians are met with only exceptionally, it is to be hoped that prospecting will be continued more thoroughly than heretofore.

When the Spaniards came back to New Mexico, about the close of the seventeenth century, it was, as reported at Taos, expressly stipulated by the Pueblo Indians that they should not be allowed to engage in mining, but only in cultivating the soil. This may account for the entire abandonment of mining for a long time after that period. The mining records relating to the time before 1680 have probably been lost during the flight of the Spaniards to El Paso; a search of the old Spanish archives, at Santa Fé, has only revealed the following Spanish grants:

1685. *Nuestra Sra. del Pilar de Saragossa, en la sierrilla del Fray Cristoral*, E. and W., 45 leagues from El Paso. (Found by a soldier of the Spanish army, while retreating to El Paso.)
1709. *Santa Rosa* in the San Marcos Hill, (Santa Fé County.)
1710. *Archangel San Miguel*, fifteen to sixteen miles from Santa Fé.
1713. *El Glorioso Patriarca Señor San Joseph*, running north and south in the Cerro Colorado, (Embuda.)
1713. *Nuestra Sra. de los Reyes de Linares*, an old covered up mine in the Sierra de San Lazaro, (Old Placer Mountains.)
1714. Gift of the same mine or part of it, (north and south.)
1717. *San Pablo*, five leagues from Santa Fé, between Cienega and Cienegilla.
1744. *Nuestra Sra. del Pilar de Saragoza*, (registro,) three leagues del Pueblo San Lorenzo de Picuries.
1744. *San Antonio de Padua*, (east and west,) three leagues from Picuries.
1744. *Santa Rosa de Lima*, (east and west,) two leagues from Picuries.
1763. *Calchihuite.*
1764. *Nuestra Sra. de Dolores*, one league south of the Cerillos ranch.
1818. *La preciosa Sangre de mi Señor Jesu Cristo* at Abiquiu, in the Sierra del Cobre.
1830. *Santo Niño*, (conveyance of,) in the Oro Mountains.
1833. December 18. *Santa Rosalia*, José Francisco Ortiz, in the Sierra de Oro, west of the Mina del Compromiso, (north and south.)
1833. December 19. Mine adjoining the Ortiz mine.
1846. *Santo Niño*, north of the Ortiz mine, (old placer.)
1846. Mine in the Real San Francisco del Tuerto.

In the Taos Valley, at the foot of the Pueblo Mountains, gold has en found, according to Mr. Kroenig, Lucien Stewart, and others. On reservation of the Pueblo Indians prospecting is prohibited by that be, but north of it, about twelve miles from Fernandez de Taos, the royo Hondo and the gulches west of the Cañon del Agua are known contain sufficient quantities of gold to make washing for it by means hydraulics and cheap labor a remunerative business. The placers near n Cristoval, Garapata, and Lama Creeks are also auriferous. In the ter locality considerable washing has been carried on formerly. In acequia (ditch) near the town of Rio Colorado, the natives have often en seen washing gold, and near San Cristoval, Mr. Kroenig, an old ident of New Mexico, found a nugget worth about one dollar. Near Rio Colorado a silver mine was worked several years ago, and Messrs. tapie and St. Vrain mined silver ores from a lode near the plaza San tonio. Last year the Arroyo Hondo Mining and Ditch Company, have cted a 20-stamp mill in a very promising locality, about one-half mile ove San Antonio. Their ditch furnishes ample power to propel the mps, and as the wages of Mexican miners are only one dollar per day d provisions, wood and timber are very plentiful and cheap, the ex- ordinary combination of all the facilities for working very low grade s seems to forebode a success. The mill is set up but as yet uncovered; stamps weigh 425 pounds each, and are propelled by a 30½-inch Lef- 's turbine wheel. The whole cost of the mill, including freights, has en $9,150. It was manufactured by Gates, of Chicago. The freight m Chicago to Arroyo Hondo has been eight cents per pound, and m the end of the Kansas Pacific railroad to Arroyo Hondo, four nts.

The hill out of which the company are digging their ore consists of enite and talcose slate, and is perfectly covered with float quartz. So they have been working on an immense surface slide, called "the nk," the quartz of which prospects very well, and in which exceed- gly rich specimens showing free gold have been found. Yet the result s not been satisfactory, although the cost of milling is estimated by cien Stewart, one of the owners, to be only 80 cents per ton. The nes are not yet sufficiently opened to furnish a regular supply of pay- g ore to the mill.

The mountains between Taos, Picuries, and Embuda, contain, also gold ines which have been worked in former years. The mountains and lches near Mora contain float quartz and gold, but are not much pros- cted. This place is situate west of Fort Union, in a very pleasant lley, which abounds in water, timber, and grass lands. In all these st-mentioned districts the gold occurs free, and is easily extracted by e common stamp-mill process. Some gold has been brought to Santa during the last year from the San Juan, but no particulars could be rned about it.

Silver has not been produced in the Territory during the last year, though many mines carrying that metal exist in its boundaries. The incipal silver-bearing localities are the Organ Mountains, the Cerrillos, e Sandia Mountains, the Madalena Mountains, Pinos Altos, and the os Mountains. The two last places have already been described.

The Organ Mountains, so called from the immense cliffs, resembling gan pipes, which appear in them in many localities, are situate in the uthern part of the Territory, 15 miles west of Las Cruces, on the Rio ande del Norte. The valley of the river at this point is very beautiful d fertile, and is known everywhere as the Mesilla. A tri-weekly stage e between Santa Fé and Albuquerque, and a weekly one between

Albuquerque and Mesilla, connects this part of the Territory with its capital. The distance from Santa Fé to Mesilla is, according to the schedules of distances in the office of the general commanding the district of New Mexico, 279.65 miles. The rocks constituting the Organ Mountains are porphyry, palaeozoic metamorphosed sandstones, and carboniferous limestone. The latter two encase lodes of argentiferous galena, iron pyrites, copper glance, carbonate of copper, and the products of decomposition of galena and pyrites, together with a gangue of calcareous spar and heavy spar. The lodes are generally of good width, frequently as wide as six feet, and some of them have been worked successfully in former times. A Mr. Stevenson is reported to have taken $20,000 in silver out of his Stevenson Mine. The scarcity of water at the mines and the fact that the region is unfortunately very much exposed to the Apaches, are the principal impediments to successful mining.

The *Stevenson* and *Adelia* mines have been described by Professor R. E. Owen, and E. T. Cox has assayed some of the ore. A specimen from the Stevenson contained 36 per cent. of lead and 1.8 per cent of silver.

The Cerrillos, 17 miles southwest of Santa Fé, contain many silver-bearing lodes, which have never been described, although they are well worth it. They are situate on an old Spanish grant belonging to the Baca y Delgado family. The Cerrillos are a series of low undulating hills, about six miles long and three miles wide, and consist mostly of granitic rocks; a few of them are of volcanic origin. From a cone made up of basaltic lava near Martin's ranch, a splendid view of the Old and New Placer Mountains in the southeast, the Bernalillo in the southwest, Santa Fé in the north, and the Jenez Range in the west, is spread before the visitor. Through the kindness of Don José Baca y Delgado, the following mines could be visited under his guidance:

Santa Rosa, discovered forty years ago by Alvarado, is situate in a small valley surrounded by hills. The inclined shaft is 50 feet deep, but mostly caved in. The lode is 6 feet wide, strikes north 23° east, and dips 80° northwest. The walls are granite, and encase argentiferous galena, zincblende, iron, and copper pyrites, in a gangue of hard quartz. About twenty tons of ore are lying on the dump. Cedar and pine are abundant in the neighborhood.

Mina Rueleña.—The lode consists of two layers on the surface, one of which is three feet, the other one foot, wide. It crosses the stratification of the country rock, (granite,) strikes north 15° east, and dips 80° southwest. The ore consists of galena, zincblende, iron and copper pyrites, and the products of decomposition of these ores, all in a gangue of quartz and partly decomposed feldspar. The inclined shaft on this vein is 120 feet deep.

Mina del Tiro is situate on the east side of the Cerrillos, in the Cañada de las Minas. An incline 150 feet and a vertical shaft 100 feet deep, connect with extensive montonès (drifts) of over 300 feet in length and with many chambers. All are filled with water. The remains of an old canoe, which was used for crossing water in the mine, are still there. These excavations were made by the Jesuits, probably before 1680, and the expense has been estimated at $100,000. Silver ore is visible in large quantities. It consists of the same minerals as described in the above-named mines, but zinc-blende is so predominant that the ore was found refractory in smelting. The proper way to work it would be by chloridizing, roasting, and amalgamation. Salt for this purpose can be had in large quantities at the salt lakes south of Santa Fé.

Calchihuite (Turqnois) is an immense mine, entirely caved in. It was rmerly worked by the Pueblo Indians for turquoises. Small seams of iis mineral are still visible, but it seems to be of an inferior kind. Two irge gems from this place are said to have been presented by the In-ians to Charles V.

Many other mines and silver lodes were visited, but the former were oo much caved in, the latter too little opened to admit of anything like reliable description. It may be mentioned, however, in this connec-ion, that an assay of a specimen of very coarse galena from one of the ist-mentioned veins gave a result of 76 per cent. of lead, and $42 75 ilver per ton.

The *Sandia* Mountains are very little prospected. They are situate etween Albuquerque and the New Placer, and contain many regular nd well-defined lodes of argentiferous galena in a gangue of calcareous ar. A sample assayed from one of these yielded $33 75 silver per ton 2,000 pounds.

The *Madalena* Mountains are situate about thirty miles west of Scor-, a town on the Rio Grande del Norte, and one hundred and forty-three uth of Santa Fé. Three years ago a California miner found a very h piece of silver ore in these mountains, and subsequent prospecting peditions resulted in the discovery of many lodes, most of them small, it rich in copper and silver. A specimen yielded, by assay, $109 06 ver per ton; others are reported to have assayed as high as $500.

The *Santa Juliana* lode is said to be a very large galena lode, which rries $9 per ton in silver. Most of the veins have been but very im-rfectly opened, as will be seen from the following description of the gion:

The Madalena Mountain range rises abruptly from the plains to a ight of over 2,000 feet. It extends about forty miles in a north and uth direction, and is on an average three or four miles wide. The incipal rocks constituting it are limestones and metamorphosed sand-ones. The mineral-bearing veins are found on the summit and along e western slope of the range, the greatest number being located on its rthern end. Some of the cañons along the sides of the mountain con-in placer gold, but the quantity is insufficient for profitable working.

The *Washington* lode is located at the summit of the range near its rthern end, and forms the crest for a considerable distance. It strikes rthwest and southeast, and dips about 35° to the southwest. It large and well defined and carries copper, lead, silver and gold ores. he first named are predominant. The openings, so far, are inconsid-able, the deepest shaft being less than 30 feet.

The *Chavez*, south of the Washington, on the summit of the range, has arly the same strike and dip, and appears to be its extension. It is contact vein between the limestone and sandstone, and carries the me ores as the Washington; the lead ores, however, predominate.

The *Santa Juliana*, at the base of the western slope of the mountain, s the same strike and dip as the Chavez. It is a very large vein, from to 20 feet wide, and has been traced on the surface for a long stance. It contains, principally, carbonates of lead; besides this, cop-r, silver, and gold. The gangue is impregnated throughout with min-al, and the vein is undoubtedly capable of producing extraordinarily rge amounts of ore when properly opened. Good pine timber and nty of water are close at hand on every side, and the adjacent plains e covered with a luxuriant growth of gramma grass.

The *Hubbell* is located in a small range of low, grassy hills, about ven miles northwest of the Santa Juliana. It strikes northwest and southeast, and stands nearly vertical. The vein is small, but its very straight course can be traced on the surface for a long distance. The ores seem to be formed by the decomposition of fahlerz, and consist of carbonates of copper, chloride of silver, &c. They are very rich and can be reduced by amalgamation.

The *Corona de Pueblo* has the same strike and dip and carries the same ores as the Hubbell. A number of similar veins are in the same vicinity, all of which are only slightly opened. They are situated in the pass about twenty miles east from the Rio Grande. The Corona de Pueblo is ten or twelve feet thick, dips at a slight angle, and carries carbonates and copper glance. It has been very imperfectly opened; the shaft, 20 feet deep, has not yet passed through the vein. The ore contains a small amount of gold and silver.

About a year ago adobe furnaces were erected at some of the Madalena mines and considerable amounts of ore were smelted. The enterprise was, however, unsuccessful.

Whenever railroads shall traverse this country, its mines will be of great value, as they will possess then every facility for successful working. For present working the ores are too poor in the precious metals to stand the large cost of transportation for supplies and the metal.

The principal copper mines of the Territory have already been described. Besides those already mentioned, the mountains between Taos and Moreno, at Abiquiu, Tijeras, and Manzano, may be enumerated as localities rich in copper ores. The mines of Nacimiento and Jemez, where small seams of native copper occur between layers of sandstone, have been abandoned, as have also those of Tijeras. Most of these mines are not likely to be successful until railroad communication with the civilized world is established.

Some of the gold lodes near Real del Tuerto, however, might be worked to a profit even at the present time by extracting both gold and copper by means of the proper dressing and smelting works. There is so much gold ore carrying a large percentage of copper found at these mines, that a very successful business could be done on that basis, especially as the anthracite coal of the vicinity furnishes a very cheap and convenient fuel.

CHAPTER LIX.

COAL AND IRON ORES.

The occurrence of anthracite coal in workable beds in the western Territories near the gold and silver districts is of such great importance, that I cannot conclude this report on New Mexico without giving a detailed description of the *anthracite mines* at the Old Placer Mountains. They are situated near the northwestern foot-hills of that range, about twenty-three miles southwest of Santa Fé, and, respectively, four and one-half and six miles from the mining town of Real de Dolores.

It is well known that anthracite beds occur in almost all formations, though they are mostly found in the older rocks of the palæozoic era, and always in localities where these rocks have either been considerably disturbed by eruptions and upheavals subsequent to the deposition of those strata, or where hot, molten masses, though they have not disturbed the original stratification of the neighboring rocks to any considerable extent, have, at a former period, exerted tamorphosing influences on them. Thus the fact has been satis- torily established in many coal beds of great extent, that they may one locality consist of a true anthracite, while in another locality, ıote from the causes of metamorphism, the same beds, determined such by the inclosing strata and the fossils found in them, may con- n bituminous coal, or even lignite.

ın entirely analogous case is presented by the anthracite beds of the ıcer Mountains.

ſrue anthracite has a specific gravity of 1.4 to 1.7, its hardness is :.5, and it contains 85 to 93 per cent. of fixed carbon. Volatile tter after drying, 3 to 6 per cent. It is amorphous, of conchoidal cture, brittle, has a sub-metallic luster, iron-black to grayish and ›wnish-black color, and when pulverized forms a black powder. It ıites with difficulty and at a high temperature, but when ignited pro- ces an intense heat. The coal from the coal mines to be described in following, presents all these qualities, and there is, consequently, no ıbt that it is really anthracite.

ıt present, two mines, one and one-half miles distant from each ıer, are opened by the New Mexico Mining Company.

ı wagon road leads from Real de Dolores in a northwestern direction ›und the foot-hills of the Old Placer Mountains to the new anthracite ne. Before reaching the mine, the road leads through a ravine parallel those where the coal bed is exposed and about 250 yards distant from em. Here the outcropping rocks consist of nearly horizontal layers massive sandstone, which is covered with an overflow of porphyry. dike of the same rock is found on the lower side of the croppings of e Cunningham gold mine, from where it has been traced with slight erruptions over six miles to the old anthracite mine, forming a cap the massive sandstones of the coal-bearing formation. The new nes are situated at the junction of two small ravines, forming a larger e, which descends gradually, first in a northeastern, then in a rthern direction toward Galisteo Creek, two and one-half miles dis- nt from the mines. The lower wall of the coal bed is nearly level ith the bottom of the arroyo, and as the dip is about 15° southeast, ward the ravine, the position of the bed is certainly an exceedingly vorable one for opening and working. It has been opened in two fferent localities, on the eastern side of the south branch of the ra- ne at the junction of the two smaller ones, and on the western side of ıe same branch about 50 feet south of the first opening. The first one llows the dip of the bed for a distance of about 35 feet; the whole cline, 5 feet high by 5 feet wide, is excavated in solid anthracite, and ıows the bed to be of great regularity. The following strata accom- ınying this coal-bed are exposed to view in this locality from the bot- m of the ravine to the top of the hill:

ırbonaceous shales	1 foot
ıthracite	5 feet
ırbonaceous shales	1 foot
durated clay	4 feet
ıminated argillaceous sandstone, containing fossils	25 feet
ıssive sandstone	100 feet

In the second locality the coal is opened by three tunnels, two 25 feet ng and one 40 feet long, showing the same strike and dip of the bed the incline. The anthracite, however, is only 4 feet thick, while the ickness of the shale varies from 3 to 4 feet.

About 280 tons of coal have been taken from this mine. It shows all e qualities of a true anthracite, contains 87.5 per cent. of fixed carbon, and when burning, shows only the short, blue flame of carbonic oxide. The steam-boiler of the engine propelling the New Mexico Mining Company's stamp mill has been successfully heated by it. A hundred pounds brought to Santa Fé were used by Mr. Bruckner in his assaying furnace, in order to test the heating power practically. He found that a white heat was reached in a very short time, and that this heat lasted about three times as long as that produced by an equal weight of charcoal. As the material does not coke in the least, it is evident from this test that it is perfectly adapted to use in blast furnaces, though it will require a higher pressure of blast on account of its density, than charcoal or coke. As far as its application for all practical purposes is concerned, it is undoubtedly fully equal to Pennsylvania anthracite and really the best fuel discovered so far in the West.

The second coal mine is situated about one and one-half mile southwest of the one just described. Between the two mines exists a bed of excellent fire-clay, some of which was tested by Mr. Bruckner, in Santa Fé. He made a scorifier out of it and smelted lead and borax in it in the hottest anthracite fire. It neither cracked, nor was it attacked in the least by the flux, so that this test speaks well for its use as fireproof material in furnaces.

Between the fire-clay and the following sandstone stratum a bed of iron ore is found. Both carbonate of iron and hematite are present. Ores of this kind as well as boulders of magnetic iron ore and large deposits of the same abound in the mountains of the Old and New Placer. Thousands of tons of large boulders of great purity can be collected, for instance, near the old anthracite mine, away from the different extensive deposits of magnetic iron ore, which occur in the same locality.

The second anthracite mine, spoken of above, is opened by a tunnel 90 feet in length driven into the coal bed near the entrance of a steep ravine, the sides of which are nearly perpendicular. It is started near the bottom and on the west side of this ravine, rising with the dip of the strata, which, as in the locality spoken of first, is 15° to the east. The following succession of strata, commencing at the bottom of the ravine, is visible:

Anthracite 2 feet; slate 10 inches, diminishing toward the breast of the tunnel; anthracite 1 foot 6 inches; alternating layers of shale, iron ore and sandstone varying from 5 to 9 inches in thickness; laminated argillaceous sandstone, containing fossils; and 12 feet of massive sandstone, overflowed by felspathic porphyry. The latter rock forms the east bank of the ravine from top to bottom. About 100 tons of anthracite of an excellent quality have been taken out and are lying on the dump. Long exposure to the atmosphere through summer and winter have not altered its compactness in the least. It is of jet black color and contains 88 per cent. of fixed carbon and 5 per cent. of ashes of a brick-red color.

Although roving bands of hostile Navajoes visit this locality sometimes, and even have their usual camping place at the coal mine, the splendid opportunity offered here for procuring a cheap and superior fuel for the surrounding mining districts will undoubtedly be more extensively made use of very soon. For those who intend the erection of metallurgical and especially smelting works for the beneficiation of the more rebellious gold and silver ores, and also for copper and iron smelting establishments, the occurrence of these anthracite beds is of the utmost importance, and will no doubt be duly appreciated.

At the south side of the Old Placer Mountains, at a distance of ten miles from the above described coal beds, an anthracite vein has been ened in the second arroyo east of the rancho near the spring on the ad from Tuerto to Dolores. There are two pits of a depth of about 6 et. The first one shows the following section: Shale 2 feet, anthracite 10 inches, shale 8 inches, anthracite 2 feet. The strata course north 7° east and dip 75° northwest. The second pit is located within 100 et from the first, and contains only a six-inch seam of coal, which conins a great deal of sulphur.

Another coal bed is exposed near Galisteo Creek, but as the locality uld neither be visited nor a specimen procured from it, its nature and e quality of the coal could not be determined. Indications of coal il are said to exist here, as well as two miles north of Santa Fé, here a layer of coal mixed with iron pyrites occurs.

Of the many different localities where coal veins crop out in the Tertory, I will only mention the following: On the reservation of the ueblo Indians near Taos, at the foot of the Pueblo Mountains; in e Raton Mountains, on the Vermejo River near Maxwell's, where e beds are 6 feet thick; on the Purgatoire River, near Las Vegas, at e Rio Puerco, in the San Mateo Mountains, and in numerous places est of Fort Wingate; a large bed exists near Fort Craig, (San Pedro.) ost of these beds have been ably described by Dr. John L. Leconte in is notes on the geology of the survey for the extension of the Union acific railroad, eastern division, from the Smoky Hill River to the io Grande, Philadelphia, 1868.

Coal has been used to a very limited extent so far. The Vermejo nd San Pedro coal are used for blacksmithing; the latter also for doestic purposes at Fort Craig. The anthracite from the Old Placer, as already been stated, is used for the heating of a steam boiler. one of the new Mexico coal has so far been used for metallurgical urposes, although some of it is very well adapted to such use. No ttempt has ever been made to smelt iron, although ores exist in great bundance and of great purity in the immediate vicinity of anthracite oal and contiguous to fire-clays and limestone.

Iron ores occur in beds, and as float boulders in the form of carbonate nd hematite in the coal measures; as magnetic iron ores they accomany the gold-bearing formation. Every gulch and river in this formtion contains magnetic iron sands, the "marmaje" of the Mexicans; nd pebbles and boulders of great purity, the "tepurtite," or "la guia el oro," of the native miner. Large lodes of it, with huge croppings, re found together with gold veins at the Moreno Mines, (Nacita Gulch;) t the south side of the Old Placer Mountains the Mammoth lode conains such ore; in the New Placer Mountains east of Tuerto are very xtensive croppings of pure magnetite; and immense quantities of it exist t the Hanover copper mines near Pinos Altos, while a large lode of pecular iron ore has been found of late near Embudo (between Taos nd Santa Fé.)

The following resumé of the ores and minerals found in the Territory f New Mexico up to the present time speaks well for its resources:

I. *Gold.*—1. Placer gold, accompanied by magnetic iron sands, occurring in all streams and gulches near quartz lodes. 2. Gold in quartz lodes, in white and blue quartz with magnetic iron ore, oxide of iron, iron pyrites, manganese, malachite, azurite, copper pyrites, galena, and zinc-blende.

II. *Silver.*—In argentiferous galena, zinc-blende, iron and copper pyrites, malachite, and azurite, in fahlerz and grey copper ore.

III. *Lead ores.*—Carbonate, sulphuret of lead, &c.

IV. *Copper ores.*—Native copper in river beds and lodes, red oxide, malachite, azurite, copper pyrites, copper glance, variegated copper.
V. *Manganese.*—Binoxide, oxide, silicate, and carbonate of manganese.
VI. *Iron ores.*—Carbonate, hematite, specular iron, magnetite.
VII. *Coal.*—Anthracite, bituminous coal.
VIII. *Salt.*—In salt lakes and springs.
IX. *Precious stones.*—Garnets, turquois, opal.
X. *Quicksilver.*
XI. *Soda.*
XII. *Gypsum, lime, cement, sulphur, sulphuret of iron, chromic iron, etc.*

CONCLUSION.

It is difficult for the uninitiated to understand why the Territory of New Mexico, with all her resources, produces so very little. Yet there are several reasons which, so far, have prevented the rapid progress this part of the country should be expected to make.

At the head of the list stands the apathy of her own inhabitants. There are about 90,000 native Mexicans and Indians, 3,000 persons born in the States, and about 9,000 foreigners in the Territory. The larger part of the Americans and foreigners have found profitable employment under the government or in mercantile pursuits, and the Mexicans are generally very poor and content to earn enough for the bare maintenance of their lives by cultivating the soil. The hostility of the Indians is a great drawback, and the military authorities, as well as the Indian commissionors, have so far been ineffective to stop the depredations of the red man. Immigration only can overcome these evils, and that is greatly hindered by the prairie wilds and long distances without railroad communication which separate the Territory from the States.

Sooner or later, however, it will be known that New Mexico need not shrink from a comparison with her sister Territories; none of them surpass her in natural resources and riches, and many of them stand below her in the scale.

PART II.

UNITED STATES MINING LAW.

UNITED STATES MINING LAW.

he following letter was addressed to me, at my request, by Hon. E. unne, of White Pine County, Nevada, a gentleman who formerly ded in Humboldt County, and whose legal knowledge, as well as his familiarity with the conditions of title, etc., of mines on the public ls, entitle his views to the most respectful consideration:

WASHINGTON, D. C., *December* 20, 1869.

EAR SIR: You have asked me to state what I have observed with ird to the workings of the national mining law—how it is liked; it faults, if any, are found with it; and what improvements, if any, proposed; and to embody in the form of amendments such sugges- s as I have met with as seem worthy of approval.

hesitated long before promising any compliance with the last request, experience in mining codes having taught me that while it is easy oint out defects, the cure for them requires great time, thought, and , combined with a knowledge of the subject difficult to attain. I disposed to be grateful for the benefits secured by the act in ques- , and to look with distrust upon any attempt to supplant it with a e elaborate code, fearing that to open the subject again might eril advantages already gained; but when I came to understand position better—when I saw that you were as anxious as any of miners could be, to preserve the most popular features of the law paired, and only sought to add to the efficiency of the act by ndments with regard to details, which it is universally admitted the general draught of the law did not cover, I felt bound, of course, to nything I could to aid in the matter. It is only by a free inter- ge of sentiment on the part of all who are affected by the law, that information can be obtained which is necessary to enable any one raught general provisions which will be applicable to the vast extent ountry sought to be brought within the operation of the act. My rvations have been confined chiefly to silver mining in the State of ada, yet it is with great diffidence I venture some suggestions as ibly being applicable to that branch of mining within even that paratively limited area. How they would affect California, Colorado, ew Mexico, Arizona, Oregon, or Idaho, Montana, Washington, Wyo- g, or Dakota, in silver mining alone, to say nothing of gold, cinna- or copper, which the law also covers, is more than I can tell. There great probability, also, that we will before long acquire jurisdiction the Mormon Territory of Utah, when further modifications in the may be necessary. If we had a full discussion of this subject from different regions mentioned, we might then hope to educe some gen- principles applicable to all. We cannot expect a satisfactory law day. If we succeed in getting a good one after ten years' careful k, we shall be fortunate indeed.

RETROSPECT.

great many persons feel that what they call interference in this ject by Congress, is somewhat in the nature of an infringement upon established rights. A slight review of the status of the case may cause such persons to look upon the matter in a different light. Up to the year 1866, we had no general law on the subject of mining, nor any official declaration as to what policy the government intended to pursue with regard to the precious metals in its soil. The general policy of nations had been to reserve these treasures as *jura regalia*, and thus treat them as the special property of the sovereign, to be mined under such regulations as might from time to time be ordained; to be licensed, leased, or granted, as might at any time be thought best. In older times, when all authority was concentrated in a single sovereign, who could quickly adopt and easily enforce any policy he pleased, it is easy to see how a system which furnished so convenient a means of revenue was eagerly established. But the discovery of our precious metals, in quantity worthy of national consideration, came in the midst of great excitement, right after the Mexican war; the mines were in a distant region, and before the government was able to acquire any definite knowledge of the extent of the deposits, hundreds of thousands were engaged in working them. To determine upon a governmental policy in the matter, required, not the will of a single sovereign, but the concerted action of some hundred members of Congress, to whom the subject was new and the information thereon scanty and difficult to obtain. As a natural consequence, nothing was done at that time. The ultimate rights of the government, it was argued, were safe. They could be asserted at any time. Meanwhile, the people, finding some law necessary, began to make regulations for themselves. Whenever a number of miners found themselves working together in a certain locality, they called a meeting, organized a mining district, established its bounds, defined the extent of ground each man might hold, and fixed the amount of work he should do per month, or per year, to retain it. They enforced these rules *vi et armis* at first. Very soon the courts, in the absence of other laws, and finding these codes well suited to the cases coming before them, adopted them as the rule of judicial decision. The system thus instituted in California, gradually spread to the adjoining States and Territories. It had some imperfections; it gave no absolute title to the mine. If a man left his district, he was liable to find the law of tenure changed and his claim "jumped" on his return; but on the whole, the miners preferred to let the system stand rather than ask any aid from Congress. All they wanted from the government was uniformity and stability of tenure, with the right to purchase the absolute title when their labor had demonstrated the value of the claim; but they feared to agitate that question, lest the price should be placed at a figure beyond their reach, and so, by common consent, they kept very still on this point, and worked away under the let-alone policy of the government.

NEW POLICY PROCLAIMED.—THE GOVERNMENT ASSERTS ITS RIGHTS.

For nearly twenty years the government had quietly looked on at all this work of the miners, saying nothing, not knowing what to say. Nobody was complaining. Millions of dollars were rolling into the great cities of the East every month, trade increasing, manufactories thriving, and everything seemed to be working well enough without the need of interference. But now came a great difficulty. The government, for the first time in many years, began to be pressed for money. It had just emerged from a great war; was burdened with an enormous debt; heavy taxes were levied, and still the treasury was empty. Suddenly there rose a party in the East with the cry, "Sell the mines! they'll pay the debt!" The thing took. Bills were introduced in both houses of Congress immediately. I do not remember the details of the bills, but I understand the main feature was to put the mines up at auction and sell to the highest bidder. This principle was particularly odious to the miners, and roused their indignation to the highest pitch. At a tremendous sacrifice of life and health, of the comforts of home, and the pleasures of civilization, the vast regions of the far West had been explored, and these mines discovered and made valuable by the labor bestowed upon them. It was notorious that, as a class, the miners were poor. They had sent forth millions upon millions to quicken the pulse of trade, but received in exchange only the necessaries of life, which were quickly consumed; while the gold produced, and the profits on the articles consumed, were both gathered to the money centers of the East. To sell the mines as they then existed to the kings of these centers, as the highest-bidder plan would necessarily do, would have been to sell them not only the bare title to the mines, but also the lives and the labor that had been sacrificed to make those mines what they were. If the sentiment in other regions on this question was similar to that in Nevada at the time, I do not exaggerate at all when I say that no such law could ever have been enforced. Fortunately, the mining interest was ably represented in Congress, led by Senators Stewart of Nevada and Conness of California, both thorough masters of the subject. They grappled the question with all their power, knowing it was a matter of life or death to the regions they represented, and, after a desperate struggle, defeated the highest-bidder plan, and achieved a complete victory for the principles most anxiously desired by the miners, namely, the recognition of their mining laws, and the right of the discoverer of a mine to purchase the title from the government at a reasonable price. No matter how defective the bill may be in detail; no matter how many points it leaves entirely untouched; the miners will ever be grateful for its passage, for in that, to them, memorable session, it was not a question of detail nor perfection, but a struggle between two great conflicting principles, and the policy desired by the miners prevailed. Still, we must remember that the quartz-mining interest is yet in its infancy. It has not had twenty years' growth yet, and it is an industry which a thousand years of exploitation will not exhaust. It behooves us, then, to elaborate our mining code with the utmost care; to give it the greatest attainable perfection of detail, and, at the same time, to generously enlarge its scope until every branch of mining industry receives the fullest protection it is possible to afford.

HOW THE LAW IS REGARDED.

Gregory Yale, in his excellent work on Mining Claims and Water Rights, who may doubtless be taken as expressing the general feelings in California, says of the law: "As the initial act to the legislation which must necessarily follow, it is more commendable as an acknowledgment of the justice and necessity which dictated it, and for its expediency as a means to the advancement of the State and nation than for the perfection of its provisions, or their exact adaptation to the accomplishment of the object intended."

Mr. Yale hastens, however, to deprecate unfriendly criticism of the act on this score, acknowledging that more was done at the first stroke than we had reason to expect. So far as I have been able to judge of the sentiment of Nevada, the only place where I have had an opportunity of examining the operation of the law, it is much more favorable than that expressed by Mr. Yale. Nevada, unlike California, had no long line of decisions recognizing the validity of her district laws. In the so-called "outside districts" of Nevada, these laws generally provided for forfeiture and relocation of claims. An immense amount of relocating had been done, but the validity of such action was not yet judicially established. Capital was afraid to buy either the old or the new title. All was uncertainty and confusion, mines unworked, miners idle, capital standing aloof. This act at once restored order, certainty, and confidence, in such regions, by reason of the provisions of section one, which recognized the binding force of local rules and customs. A relocation made in accordance with the laws of the district became at once of as much value as though it had been the original title: people knew where they stood; capital was invested with safety, and many districts sprang into new life, directly under the operation of this section of the law. While this much must in candor be said of the first section, it is also true that while the principle of granting patents for mines is peculiarly welcome to the miners, the manner in which this principle is applied in the other sections has been so objectionable that very few applications for patents have been made, except in the comparatively few cases where the restriction of the grant to a single vein in the area claimed made no difference to the owners, from the fact that no other vein was supposed to exist in their area besides the one for which a patent was asked. This matter will be more fully set forth under title fourth, in that portion of this letter where the objections to the law are separately treated.

WHAT FAULTS ARE FOUND WITH THE LAW.

The objections to the present law are numerous, but the following may be considered as the most important:

1. Not fixing the size of the tract.
2. Allowing piratical locations to be made in the immediate vicinity of *bona fide* claims.
3. Permitting later locations within 250 feet of the center of an old location, to prevent the lateral extension of such old claim to the full width of 250 feet each side of said center.
4. Restricting the patent to one vein in the first instance, and not allowing a patentee to purchase other veins found in his area without the formality and expense of a new patent.
5. Not providing for the disposition of bodies of outlying ore often found near a productive vein, but which, strictly speaking, are not a part of it.
6. Not determining in cases where two veins cross in depth who shall have the ore in the space of intersection.
7. Not determining in cases where two veins unite in depth and become one, how the same shall be held below the point of union.
8. Granting patents before work enough is done to determine the width and course of the vein.
9. Not providing for a uniform condition of tenure of possessory claims.
10. Not providing for greater safety of district records.
11. Not providing some mode to settle the question whether a mineral deposit proposed to be patented is a vein or only a deposit, and, in case it be merely a deposit, not limiting the patentee thereof to the area granted.
12. Not extending the law to placer mines, river diggings, gravel claims, and cement deposits.

13. Not providing a mining school and surveying fund.

14. Not preventing rascals from floating a location originally placed on a worthless claim to some new discovery of greater value.

15. Allowing the register to publish the notice for a patent at such cost to the claimant as the register and printer may choose to agree upon, instead of permitting the claimant to make his own bargain for that service.

16. Not prohibiting mere extensions.

WHAT REMEDIES ARE PROPOSED FOR THESE DEFECTS.

In your report for 1868, you suggest remedies for most of these objections. I will take up the objections one by one, and place by the side of each the remedy proposed. This arrangement will have two advantages:

First. All who choose can then see exactly what objection is made. If it be too strong for some regions or not broad enough for others, parties resident therein can enlarge or modify them accordingly.

Second. If the form of the objection be satisfactory, parties interested can judge of the propriety of the remedy proposed and acquiesce or suggest improvements, as the case may be.

The general principles of the existing law are contained in the following sections:

Section 1. The mineral lands of the public domain, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and occupation by all citizens of the United States, and to those who have declared their intentions to become citizens, subject to such regulations as may be prescribed by law, and subject also to the local customs or rules of miners in the several mining districts, so far as the same may not be in conflict with the laws of the United States.

Section 2. Whenever any person, or association of persons, claim a vein or lode of quartz, or other rock in place bearing gold, silver, cinnabar, or copper, having previously occupied and improved the same, according to the local customs or rules of miners in the district where the same is situated, and having expended in actual labor and improvements thereon an amount of not less than one thousand dollars, and in regard to whose possession there is no controversy or opposing claim, it shall and may be lawful for said claimant or association of claimants to file in the local land office a diagram of the same so extended, laterally or otherwise, as to conform to the local laws, customs, and rules of miners, and to enter such tract and receive a patent therefor, granting such mine, together with the right to follow such vein or lode, with its dips, angles, and variations, to any depth, although it may enter the land adjoining, which land adjoining shall be sold subject to this condition.

Section 3 points out how the proceedings in applying for the patent shall be conducted, and how the survey shall be made, closing with the clause: "But said plat, survey, or description shall in no case cover more than one vein or lode, and no patent shall issue for more than one vein or lode, which shall be expressed in the patent issued."

Section 4 permits a departure from a rectangular form of survey, and ordains "that no location hereafter made shall exceed two hundred feet in length along the vein for each locator, with an additional claim for discovery to the discoverer of the lode, with the right to follow such vein to any depth, with all its dips, variations, and angles, together with a reasonable quantity of surface for the convenient working of the same, as fixed by local rules;" and provides, further, "that no person may make more than one location on the same lode, and not more than three thousand feet shall be taken in any one claim by any association of persons."

Section 5. As a further condition of sale, in the absence of necessary legislation by Congress, the local legislature of any State or Territory may provide rules for working mines, involving easements, drainage, and other necessary means to their complete development, and those conditions shall be fully expressed in the patent.

Section 6 ordains that in case of contest of title all proceedings relative to a patent shall be stayed until the question is decided in the local courts.

Section 7 gives the President power to establish additional land districts, as may be necessary.

Section 8 permits the construction of highways over public lands.

Section 9 relates to water rights.

Section 10 allows pre-emptions to homesteads on lands formerly designated as mineral lands, when no mines, up to the time of pre-emption, have been discovered on them.

Section 11 and last gives the Secretary of the Interior power, after survey, to designate what lands shall be treated as agricultural and what ones shall be considered mineral lands.

The foregoing synopsis embraces all the principles of the act relating to mining. I will now proceed to the objections made and the amendments suggested.

FIRST.

Objection.—That the area of the tract granted is dependent upon the laws of the district in which the claim is situated, and consequently is subjected to all manner of variations as to its extent.

Remedy suggested.—Let the law prescribe the area, regardless of miners' customs.

Comments.—What size should be prescribed? That it ought not to be more than three thousand feet in length upon a vein, most are agreed. But is it right, some may ask, to compel a man to pay for more than he wants to buy? No; but the government can say what sized tracts it will sell, and parties may buy or not, as they choose. Where a vein crops the whole distance, the claimant will cheerfully take the full extent of three thousand feet; but when it crops only five hundred feet in length, and the remainder of the ground appears to be barren, or is broken up too much to permit of working it to advantage, or lies flat and seems to be worthless, he will wish to reject the latter part. Then, again, how shall the width be fixed? It is generally admitted that at least two hundred feet on each side of the vein should be given, when possible; but that leaves the whole width of the tract still indefinite, because the vein itself may vary from one inch to five hundred feet in width, and all of that width is to be granted in addition to the two hundred feet on each side. But as either of these extremes of width are very rare, would it not be well to fix on five hundred feet as the settled width of the area to be patented? The claimant can then select a line which he is willing to accept as the center of his vein, and take two hundred and fifty feet on each side of it. But will this meet a case where the vein itself is more than five hundred feet wide? Yes, if the principle of consolidation hereinafter suggested in title second be also adopted. If the width be fixed at five hundred feet, no claim should be permitted to be of less length than a like number of feet. What shall be done with fractions less than five hundred feet, occurring when two claims run toward each her on the same vein, but are stopped by the three thousand feet limit fore they join? Treat them like fractions in the agricultural surveys. clude them in the patent of the nearest owner. We fix the area which claimant of agricultural lands may receive; why not with mineral nds also? The government has a direct interest in seeing that no iims are too small, as well as in preventing their being too large. iere is such a thing as cutting up a piece of valuable ground into such ipracticable shapes that it will be of no benefit to any one; and in the atter of division the owner, and not the purchaser, should decide. It to the interest of the government to see that these mining claims are rge enough to justify the great outlay necessary to thoroughly prosct them. It is wrong to permit any one to locate as small an amount two hundred feet along the line of a vein. The Comstock was ined by small locations. They are the death of legitimate mining, and ailable only for the worst kind of stock-jobbing purposes. One deep aft will suffice to work a claim two thousand feet long. Ten will be eded to work ten claims of two hundred feet each, when held sepatelv, as they may be and often are now. All of the labor on nine of ese shafts is lost to the public, and that is one of the parties interested this matter; for the country is enriched from mining in proportion as e yield of bullion exceeds the cost of production. Labor is capital just much, so far as kind is concerned, as money is. Labor and money mbined make capital which may produce property. Either of them r itself is also capital; but labor can produce property working alone, hich money can never do. A waste of labor is just as serious a loss a country, so far as it goes, as a waste of money. Successful mining, a rule, requires a proper application of science, money, and muscle. hen laws are to be framed for the regulation of the mining industry, e representatives of all of the elements essential to its existence are titled to a voice in their enactment. It does not settle the question r the prospector to say, "If I am willing to take two feet or two hunred feet, and take my chances on it, whose business is it? If it don't ay, it's my own loss." No, it is not simply his own loss. A mine has en ruined, no one benefited, and the country, as well as the miner, as lost a certain amount of labor. Neither should money or science lone determine the law; but all should consult, make the best terms ey can with each other, and abide the result.

The present supposed limitation in the law, restricting each locator to o hundred feet, is a nullity at the best, if a party wishes to avoid it. hen a prospector goes out to hunt for claims, he is generally backed y one or two persons, who contribute a portion of the expense of the ip. Among them they make up a list of names of such of their friends s do not care to engage in mining, and who readily agree to execute eds whenever called upon for any ground which may be taken up in eir names. If the prospector finds a promising vein, he locates it, ing these names in conjunction with those of the parties directly intered, setting down two hundred feet for each name. When he returns e complaisant friends congratulate him on his success and execute the eds as promised; and thus the real owners have obtained five hundred r one thousand feet each, as the case may be, virtually by location in ite of the law. As the restriction is a nullity and ever must be, so r as the good it aims at is concerned, but is still potent for evil in the it permission it gives to make small locations, why not remove it ltogether, and prohibit the cutting up of valuable property into worths fragments?

AMENDMENTS TO MEET THE FOREGOING SUGGESTIONS.

SEC. —. On vein locations made on and after the first Monday of 1870, the area for which patents may issue shall be in length not than five hundred feet and not more than three thousand feet, and be of any width not exceeding five hundred feet.

SEC. —. On vein locations made prior to the first Monday of 1870, the area may be for such amount as is claimed by the owne allowed by the district laws governing the location, not exceeding thousand feet in length by five hundred feet in width.

SEC. —. The length of a claim on a vein location, in all cases co plated by this act, shall be measured in the direction of the genera of some one vein in the area claimed, said vein to be designated b claimant.

SEC. —. On deposit locations made on and after the first Mond July, 1870, the area shall be a square, whose side shall not be less five hundred feet and not more than three thousand feet in length.

SEC. —. On deposit locations made prior to the first Monday of 1870, the area shall be as governed by the laws under which it was n *Provided*, That when the area claimed, in cases contemplated by thi tion, exceeds an area equal to three thousand feet square, it shall factorily appear that said locations are not unreasonable in extent sidering the expense necessary for their development.

SEC. —. On and after the first Monday of July, 1870, the whole area in a mining claim for which a patent may issue, may be locat one or more persons.

SEC. —. On and after the first Monday of July, 1870, no location be made within two hundred and fifty feet of the longitudinal c line of an existing mining location.

SEC. —. All distances mentioned in this act shall be determin horizontal air-line measurement.

Notes.—1. The adoption of these sections would also require a fication of the language of section 4 of the existing law.

2. I know nothing about how these sections would affect gold or cinnabar deposits.

3. These amendments relating to area should be considered in nection with those to be set forth under objections 3 to 7, inclusive

SECOND.

Objection.—Allowing piratical locations to be made in the imme vicinity of *bona fide* claims.

Remedy suggested.—That no younger location made within two dred and fifty feet of the central line of an older location sha patentable.

Comments.—There is no objection to enforcing this principle after ties have had notice that such claims, if made, will be illegal. amendments under title first cover the ground on this point from after the first Monday in July, 1870, because, under those provision such cases can arise after that date.

But if it be sought to apply the remedy suggested for objection se to existing claims, it would meet with great opposition. It would looked upon as a virtual confiscation of such younger claims for simple purpose of insuring a technical uniformity in the law, and anathematized on every side as an infamous procrustean policy.

f these younger locations have done nothing which merits any condem-ation, and the mass of them should not be summarily deprived of life ecause the liberty which permitted their creation was sometimes abused or piratical purposes. Younger locations are often more meritorious than lder ones adjoining. It must be remembered that all valid existing ocations have been made under local laws governing the case, and that heir relative merits should be determined not by any new standard ow erected, but by the laws which permitted their creation. Examining he matter under the light of those laws, we find the process to be as ollows: An old location is made at a certain point. The laws of the istrict limited the owner to, say, fifty feet on each side of his location. ne day, or five years after, some one finds a vein within one hundred eet of that claim and locates and works it, there being no question hatever of any intrusion on the rights of the older location near by. s time rolls along, the old location, in hundreds of cases, does nothing pon its ground save slight scratching in the way of assessment work, ufficient to keep the title alive, while the younger location, near by, is orked and developed into a valuable mine. In this case it would work great injustice to refuse to recognize the younger claim as patentable. t does not answer the objection to say that the proposed remedy does ot interfere between the local rights of the claims; that the younger ocation may continue to work under the district laws if it likes, but hall simply not be patentable; that we merely wish to bring a little entle pressure upon it to induce it to arrange with the older location o that both may apply for a patent jointly; because this is playing into he hands of the old location in an unfair manner, and bestowing upon t a value, by giving it command of the situation, which it has in many ases done nothing whatever to merit. But it may be said with great ruth this is only one side of the picture. There are many cases here all the equities are on the other side; where the younger location rom the very first was intended, and ever since has continued, to be a egular black-mailing operation, a combination of chicanery, knavery, nd fraud from beginning to end. Shall nothing be done with such iratical locations? Well, it is very difficult to punish past offenses by egislative enactment without doing more harm than good. The adoption f the amendments suggested in title first would settle this question for ll time after the first Monday of July, 1870, without harming any one, nd that would be a great point gained. As to the past, I do not see hat we can do anything in this respect except to let the laws of political conomy govern. The action of these laws is somewhat slow, it must e confessed, but the great certainty achieved atones for delay. They ill satisfactorily settle the question, if obstacles in the way of their eration be removed, sooner, I think, than any other means that can devised. Let us notice for a moment how they will act, and then we y the better judge of their efficiency. Given, one of the worst of es: a district where the locations are all tangled up, lying at all tances less than two hundred feet from each other; how can it be ightened out and patents issued? Let us first classify the claims. y easily arrange themselves into three grades:

1. *Bona fide*, valuable locations.
2. *Bona fide* locations of doubtful value.
3. Mere piratical locations and worthless claims.

Permit patents to issue to all owners who desire them, granting to h just such an amount as the laws of the district permit, not exceed- three thousand feet in length on the vein. There will be no cessity of restricting the width, because the case is one where the full width allowed cannot be obtained; but determine the width by ordaining that each applicant for a patent shall take the ground half-way to his nearest neighbor, with permission to each patentee to have his patent extended on either side of his center line to the full extent of two hundred and fifty feet, or less, whenever he can show title thereto, whether by ousting his neighbors by ejectment or extinguishing their title by purchase. This would soon weed out the piratical locations, and gradually extinguish the worthless claims. Piratical locations are made only on valuable claims. They are soon extinguished, because their own excavations in pursuit of mineral are of course directed toward the main deposit. The owners of the main deposit run a drift night and day to meet them. The moment the connection is made the question is settled, and the pirates are ousted. If there is danger of their extracting too much mineral before the connection can be made, and the *bona fide* owners make a reasonable showing of facts, the courts are very liberal in granting injunctions against evident trespassers, until the owners have time to "trace them out"—that is, to extend their works in the direction of the trespass complained of, and prove an identity of deposit. There is no difficulty experienced in practice from the pirates trying to turn the tables and enjoining the *bona fide* owners, because very large and perfectly satisfactory bonds are exacted by the judge before granting the order; a condition which the free lances find it very difficult to comply with.

So much for the manner of settling piratical locations. It is tedious, expensive, and annoying, but it is very effective, and, in my opinion, is the only one which can be used without doing great damage by seriously trespassing on the rights of others. It is not the cases in hand which worry the *bona fide* owners. It is the chronic fear that new cases may be sprung upon them at any moment by an ingenious, adroit, unscrupulous rogue, who, by falsification of the record, tampering with testimony, or personal perjury, chooses to put their property in peril. Fix a time when this fear may confidently cease, and they will take care of all present difficulties.

The worthless claims are easily disposed of. Give a man the right to extend his patent over them after his purchase, and he will buy them up by the dozen, if necessary, and extinguish them.

Now, as to the difficulty of weeding out claims of the second class, namely, locations which, though made in good faith, are not of sufficient value to command the attention of capital at present, and yet are too promising to be abandoned. The owners of this class of claims rarely apply for patents. The doing of a thousand dollars' worth of work to begin with is a very serious damper on them. Then to have that followed by the delay, annoyance, and expense of endeavoring to procure a patent, with the prospect of litigation with contesting claims as an interlude, makes it a serious question to them whether the operation will pay or not. They generally conclude that it won't, and allow their claims to drag on a miserable existence from year to year. The mere doing of twenty days' work per year, hereinafter suggested, would extinguish most of these claims. Now, if the owner of a valuable mine near by could readily get his lines extended by purchasing this claim, he would easily make some terms with the owner for his title, and include it in his own area. It is not worth patenting by itself, but to the adjoining owner it is often worth purchasing to get it out of the way, avoid the possibility of further difficulty with it, and to straighten his lines.

This quickly sweeps away the great mass of the claims, those included in the second and third divisions, namely, *bona fide* locations of doubtful value, and mere piratical and worthless claims. There remain only cases of the first class, *bona fide* locations of undoubted value, which are too near each other to allow of two hundred and fifty feet on each side, and yet each desirous of maintaining its location, working its mine, and getting its patent. They have all been busily engaged in this clearing-up process, and are now able, for the first time, to look about them and scan one another's lines, with nothing to obstruct their vision. Almost of necessity the lines have been closed and no vacant spaces left, for these owners remain the sole survivors of all the titles that formerly existed in the area given. If, however, any unappropriated area still remains, divide it equally between adjoining owners. Then, if each company is strong enough to work its own property, there is nothing in the way. All of this is effected without any harsh or oppressive enactment. No one has been unjustly deprived of any right to which he was legally entitled. All has been voluntary, and of course measurably satisfactory.

I am inclined to think that an additional feature might be added for the benefit of regions where the veins lie very close and cross and recross, and are confused by slides, heaves, and breaks, so that it is impossible to say where the vein is and where it is not, and that would be the privilege of consolidation; that is to say, that where a condition of things exists which would permit the issuance of six patents, side by side, of three thousand or less feet in length, and five hundred feet in width, or twelve patents of two hundred and fifty feet each in width, or any number of patents of any width, that the parties entitled to receive those patents separately might unite in their application and receive one patent to a consolidated company, for the whole or any part of an area not exceeding three thousand feet square. These consolidations would be effected oftener than would probably be supposed. There is great difficulty in getting capital to work small isolated veins. The organization of companies is expensive. The cost of maintaining a competent mining superintendence, together with the clerical force necessary to keep the accounts of a joint-stock company, is very large, and generally greatly in disproportion to the expense actually incurred for labor in the mine. There are often a dozen small veins within an area of three thousand feet square, not one of which will, of itself, support an independent organization to work it, with a board of trustees and secretary in New York, and a superintendent traveling back and forth from the board to the mine, but which, if consolidated under one management, would be highly remunerative. This forming of big companies on small veins is the cause of so many mining failures. The mine has, in hundreds of instances, paid well on all the labor actually expended on the mine itself, and a margin which would cover the cost of reasonable management, but it has not been able to support, in addition to that, a fancy superintendent, with his fancy concomitants, a staff of clerks, and a board, secretary and officers in New York, Boston, or Philadelphia. Throw a dozen of these small veins into one consolidation, so that one patent may be issued for the whole area, and the property be worked by one organization, and such a company can succeed, and capital will easily be found to engage in such enterprises. Some may say there is nothing to prevent this consolidation being effected now, if parties are so inclined. Such persons do not understand the whole case. There is no legal restriction, it is true; but there is an economical one, which is equally potent, and that is the great accumulation of expense in procuring separate patents for all of these veins. If the owners get beyond the pecuniary difficulty of obtaining patents, then the temptation to sell separately is too great to be resisted.

When the sales have been made and the companies organized, it is useless to hope for consolidation. The officers of each company prefer to "keep the ball a-rolling," and the scattered stockholders, residents of cities far distant from the mines, know but little of the comparative merits of each claim, but are prejudiced in favor of their own, and therefore look with distrust on consolidation, fearing that they will not get a fair division of the new capital stock. But there is one place where consolidation is possible, and that is upon the ground itself before patent issues. The owners are there to see for themselves. They know well the relative value of the different claims. They can see at a glance all the advantages and disadvantages of the different locations, examine the questions of title which enhance or reduce the value of a claim, and fully understand when a consolidation would be beneficial by reason of the opportunities thereby afforded to work several mines from the same shaft or tunnel. As a general rule, they are all in need of money and anxious to sell. There is here the knowledge necessary to form an equitable consolidation, where the shares to be issued to each owner in the new company can be fairly divided in proportion to the relative value of each claim contributed to the general stock. There is also the motive of interest necessary to prompt such action. Let the law but sanction and encourage it by granting a patent for the whole consolidation, and there will soon be properties open for investments at prices to which no exception can be taken, and offering advantages to capital very rarely presented under the present system of patenting and selling each vein separately, no matter how diminutive in extent or insignificant in value such vein may be.

AMENDMENTS PROPOSED UNDER THIS TITLE.

SEC. —. When a width of five hundred feet cannot be granted to a claimant by reason of the proximity of other locations, the patent shall cover the land half way to the nearest existing valid location.

SEC. —. Any patent granted for a less area than the maximum allowed may be extended to said maximum area, or as near thereto as may be asked, by some cheap and speedy means, to be indicated by the Commissioner whenever it shall appear that the person seeking such extension is the owner of, and in the possession of, the area covered by the patent already issued, and is also the owner of, and in the possession of, the additional area claimed.

SEC. —. Veins and deposits, any portion of whose longitudinal center lines are not more than five hundred feet distant from each other, may be associated, and one patent issued to include them all, provided no such patent shall cover an area greater than an area equal to three thousand feet square.

SEC. —. When fractions less than five hundred feet in length occur upon a vein, or less than five hundred feet square on a deposit, they may be included in the patent of an adjoining owner, in addition to the area he might otherwise receive, when it shall appear that such adjoining owner is also the owner of such fraction, or is first in application therefor.

THIRD.

Objection.—Permitting later locations, within two hundred and fifty feet of the center of an old location, to prevent the lateral extension of such old claim to the maximum width allowed.

Remedy suggested.—The third recommendation in your report is di-
ted to this objection, but the case is covered by amendments set forth
ler title second.

FOURTH.

Objection.—Restricting the patent to one vein, and not allowing the
tentee to purchase new veins found in his area without the formality
l expense of a new patent.

Remedy suggested.—That the patentee of any certain area shall have
right to purchase all veins owned by him in said area by paying, in
lition to the usual fee of $5 per acre, the sum of $10 for each separate
in discovered and worked within his tract, besides the one upon which
issuance of the patent is based.

Comments.—The principle on which this recommendation is based,
mely, that a patentee ought to be allowed to own all the veins in his
ct is most important, and the adoption of it, I believe, is universally
sired by all persons engaged in legitimate mining, but I think the
m of applying it might be made more satisfactory than that suggest-
. The recommendation cited would work well enough for all the veins
covered and worked at the time the application for the patent is made.
ch veins could then be easily designated in the application and the
0 apiece included in the general payment made at that time, and
ere would be an end of it. But thousands of veins will be discovered
the course of mining operations after patents will have been issued.
would be a great annoyance to be making application for the purchase
each vein as discovered, and the charge of $10 for the purchase mo-
y would be but a very small part of the expense which the person
eking to become the owner of such vein would have to bear. The
uble and expense would vary but little from the cost of an original
tent. Now, if the principle be omitted that the patentee of a tract
ght to have all the veins contained within it, so that he can enjoy
s possession in peace, why not give them to him at once, and be done
th it? The miners want it. The only question is, will the govern-
nt be wise and just enough to grant it? Now, the government, in
is matter, is simply the people at large. When the miners ask this
ncession, they are not petitioning an absolute monarch who holds
ese treasures as a private fund from which to recruit his fortunes, and
to would look with a jealous eye on any attempt to curtail his perquis-
s, but they are consulting with fellow-citizens about a property which
owned in common. The naked title to these mines belongs to the
hole people, North, South, East, and West, but that title, of itself
one, exclusive of the labor expended upon the property, was of little
lue. While this title was thus of comparatively little moment, a vast
mber of our people, an invading army of pioneers, went out into this
w country and conquered it, undergoing as great danger and hard-
ip as the pioneers of our former West. By withdrawing their labor
m the comparatively overcrowded regions of the older States, they
ened a wider field of industry for those who remained at home. They
nt out and drew the supplies necessary to their existence from new
rces, and so made life easier for those left behind. In their twenty
rs of effort, they have made great conquests for the nation. In the
ion which so recently was almost unknown to the East, they have
en us California, Oregon, Washington, Arizona, Nevada, Idaho, Wy-
ing, New Mexico, Montana, Colorado, and Dakota—nearly half the
a of the whole country. They have opened up and established a new
l peculiar interest which requires new and peculiar legislation for its

regulation. When they ask for this necessary assistance, they ar titled to have their request considered in the most kindly and gene manner by the inhabitants of the older settled portions of the cou

There is often a disposition on the part of the latter to look at question entirely in the light of their own particular interest, a dispose of it as if the title to the mines belonged exclusively to the be doled out to the inhabitants of the mining regions in such way a secure the immediate payment of the largest amount of ready cash getting that, after all, they represent but little more than one-hal area of the country, and that, although when the people at large in council they may be able to outvote the mining interest, they sh nevertheless, approach all legislation on this subject with the gre caution. The interests involved, and the area affected by action o matter, are so great that no legislation should be pushed which do meet with a pretty general approval from those most directly conce So far as legislation has progressed, the miners are and have reas be grateful. Every step taken has been in the right direction. All ask now is a more extensive application of the liberal policy ado The particular extension herein asked is, that the patent shall with it all the mineral contained in the area granted; that that may be three thousand feet long by five hundred feet wide, and parties side by side may consolidate before application, and hav patent to cover all their ground, not exceeding three thousand square. If any one is startled at the size of these tracts, let him f on the size of the tracts, and see whether any one is likely to take up at five dollars per acre for merely speculative purposes. Some must be done to make this patent system work. Hardly any on plies for a patent now, and the only reason why they do not is o count of the infinitesimal area practically granted by reason of t striction to a single vein. Ninety-nine hundredths of the mines want the benefits of the law are not sufficiently developed to enabl owner to say with safety which body of mineral in his location i vein. He cannot tell whether there is one, two, three or more vei the area allowed him by the law of the district, and granting th some cases he may be able to say with certainty that there are veins in such area, he cannot tell which is the most valuable one he is not going to be foolish enough to clap his stakes, hap-hazar one vein, and abandon the others. If you answer, let him keep u title to the others under the district laws, he replies, "If I must d with one or more of my veins, I may as well do it with all of the don't want to bother my head with two systems at the same time, one of them covers the case, although imperfectly, while the other, th more satisfactory as far as it goes, does not go far enough to enab to abandon the first."

Now, I know one case where a company owning four lines of crop has expended one hundred and fifty thousand dollars, gold, withi area of five hundred feet square, and yet it dare not apply for a p though exceedingly anxious to obtain one, because it dare not say which line of croppings it will rely to conduct it to the main vein. consequence is, that in this case, and there are a thousand su greater or less degree, the present law, so far as patents are conce is of no benefit whatever, but is only a tantalizing source of annoy An ordinary owner in such condition can do nothing whatev can't sell his mine, neither can he work it; he can't work it, beca takes too much money; he can't sell it, even if he takes out a p under the present law. Moneyed men say to him, "How do we l it this vein which you have named in your patent is the true one? may be only a spur or a lateral outcrop. If it be either of these, the r does not permit you to connect yourself with the main vein. It may a slide—if so, there is litigation before we can shift our title back to vein." But the case would be different if a miner could present a ent for an area three thousand feet long and five hundred feet wide, h mineral cropping out in various parts of it. Then he could say, Ve think the vein is here, or that it is there; but at all events it is newhere in this area, and wherever it is, we take it." Then, again, h an area of five hundred feet in width there are often four or five le veins, not one of which will pay to work separately, but each one which carries within its location the seeds of abundant litigation, uld anything valuable near by be discovered. This amendment uld generally consolidate such claims and end disputes.

But why is there any objection made to such reasonable provisions as se? Simply because of the existence of a most erroneous impression h regard to the value of the veins. It is quite a common expression governmental circles, that one vein is as much as any one company ght to own. Those who gravely assert this proposition would be as- ished to see how it excites the risibility of prospectors who are in vein business, and who often, in their tramps, find veins which are worth the trouble of merely locating, under the loose system of dis- ct laws. A vein, although it may be a true-fissure, silver-bearing artz lode, is a thing of most variable value. Though it may have all characteristics of a true vein, it may not be big enough, or rich ugh, or anything else enough, to pay for working, and then what lue has it? If all veins were of the same size, and worth just a million llars apiece, there would be some sense in saying that one vein is as ch as one company ought to own; but as such is, unhappily, not the e, the wisdom of such an observation is not so startlingly apparent. ars are entertained that, unless the area granted is made exceedingly all, gigantic mining monopolies may be created, which will disturb economy of society, overturn all social order, and sacrifice the peo- upon the altar of the Plutonian god. But is there much prospect at we will find anywhere, in an area three thousand feet long by five ndred feet wide, a body of ore more valuable than the best of the ims on the Comstock? No such location exists anywhere now in the ited States, or the whole country would be in a blaze about it. Is ere any hope of ever discovering anything richer than the White Pine posits, where ore is found worth $20,000 a ton? Yet, right in the art of the richest portion of Treasure Hill, the Consolidated Chloride at Company owns an area as great, I think, as that proposed. Yet one complains of that company as a monopoly. The people in that inity would throw up their hats with delight, if the body of ore in at location were suddenly doubled in quantity and trebled in value, the community would benefit by it more than the owners. People too apt to forget that even the most successful mining companies compelled to pay back to their workmen seventy, eighty, or ninety its out of every dollar's worth of bullion they get from the mine. other point in this case is, that the companies always have to pay money out first, and many of them never get the dollar back.

he attempt of the present patent law, to prevent great mining mo- olies by granting but one vein, is not worthy of great commendation, ause, first, there is no danger that any company will ever find too ny veins in a space of five hundred feet in breadth, and, second, be- se, even under this law, any company that chooses can own as many mines as it wishes, simply by paying the cost of a patent for each discovered by it within its area, or purchased from original locat But the rich companies don't care for patents under the present syst unless in the exceptional cases where the mine is fully developed, the existence of but one vein satisfactorily proven.

The great object of legislation on this subject should be to encou mining, and the way to do that is to put things in such shape that ple will feel they can get large returns by engaging in that branc industry. They cannot be content with the prospect of common pro because they are compelled to take uncommon risks, and they therefore the inducement of a great reward. There need not be fear of giant monopolies. Only the ordinary mines will be consolida The best ones will stand on their own organization. Common carrie railroad, steamboat, and express companies—by consolidation can their receipts to almost any figures they choose; but no matter much mining companies may combine, the market price of their bul product will still be the same. The only benefit they can derive by solidation—namely, a reduction of the cost of production, by dimin ing officers' salaries and directing labor to better advantage—is one the government should seek to aid rather than prevent. If there is lawful means by which the government can discourage the formatio the innumerable wild-cat mining corporations, which impoverish unwary and bring such discredit on the whole business of minin ought to be adopted. Some time ago, the government, by skillful le lation, exterminated the wild-cat banks of the country, and built up porative monopolies in their place, and the people approved, becaus the greater security afforded for investment. A somewhat similar icy with regard to mining will be even more cordially sanctioned. complaint now made is that the last clause of section 3 of the limits the issuance of a patent to one vein in a tract. It can be remo by the following

Amendment.—SEC. —. Strike out the last clause of section 3 of the which limits the patent to one vein, and insert instead the words: " patent for any area shall carry with it all the right, title, and inte of the United States to any and all minerals contained within the sp granted, with the right to follow vein deposits to any depth, altho they may enter the land adjoining."

FIFTH.

Objection.—That there is no provision made for bodies of outlying almost always found near a productive vein, but which, strictly sp ing, are not a part of it.

Amendment.—SEC. —. The owner of any vein included in a paten area, which has been followed into a tract adjoining, shall be entit to all the mineral within twenty feet of the walls of said vein. Wh two veins approach each other nearer than forty feet, the elder locat shall be entitled to all the mineral contained within a space of tw feet from the walls of its vein, and the mineral contained within remainder of the intervening space shall belong to the other locati

SIXTH.

Objection.—Not providing, where two veins cross in depth, who sh have the ore throughout the space of intersection common to both vei

Amendment.—SEC. —. Where two veins cross in depth, the elder cion shall have all the mineral contained within the space of intersection, but no right to twenty feet, or any other amount, beyond said pace.

Sec. —. Said space of intersection shall be determined as follows: onnect the four lines formed by the intersection of the walls of the two eins with one another by planes inclosing a certain space, limited on e four sides by the said planes, and extending in depth as far as the tersection extends.

Sec. —. The younger location shall have such right of way through id space of intersection as may be necessary for the convenient working of its mine.

Sec. —. In case of dispute as to these lines, or this right of way, the cal, State or Territorial courts may determine the same, under such gulations as the respective States or Territories may prescribe.

Note to title sixth.—I have endeavored to define the boundaries of the pace of intersection in accordance with the memorandum you furnished e.

SEVENTH.

Objection.—Not determining, in cases where two veins unite in depth, ho shall take the vein below the point of union.

Amendment.—Sec. —. Where two veins unite in depth, the elder location shall take the vein below the point of union, including all the space f intersection. Said space of intersection to be determined, as far as y be, as hereinbefore provided where veins cross in depth.

EIGHTH.

Objection.—Granting patents before work enough is done to determine he width and course of the vein.

Amendment.—Sec. —. No patent shall issue until one thousand dollars have been expended in working the area claimed, and work enough e to permit of the width and course of the vein being determined to e satisfaction of the officer making the survey.

Note.—I have drawn this section to meet the objection as made, but I do not concur in the objection. What does the government care whether there is a mine in the area or not, so long as the claimant is willing to buy the land and pay more for it than could be realized by ny other sale? What does the government care whether the land will ield a bullion crop or not? That is the buyer's business. When a man ks for a patent for agricultural land, the government never requires proof that the soil will raise any particular crop. It sells its land for a rtain price, and looks no farther. I have heard but two reasons for e objection under consideration. First, that unless something of the nd is done, the government might sometimes be aiding in putting a windle upon the market, by dignifying the location with the grant of a tent. But the day of blind and reckless purchase of mines has passed. nes are bought now like other property, after examination. If the posed vender cannot show mineral, the fact of having a patent will t help his sale. The other objection is, that the pursuance of a too beral policy would throw many mines into the hands of mere speculators, who would hold them tied up until they could get their price, and at the bullion product would be affected thereby. There is some force this objection. It is indisputable that quite a number of mines would e so tied up and their development retarded; but in my opinion this evil would be greatly overbalanced by the greater number of mines that a more liberal policy of granting patents would bring into market. People are not inclined to hold on to an unprospected mine of unascertained value when any reasonable offer is made by capital to take hold of it, and get the bullion out of it. Rich men will not keep such a mine back, because, if the show is good, they will work it themselves. Poor men will not hold on long, because they cannot afford it. But it may be said we require the performance of certain conditions with regard to agricultural lands sometimes, such as residence and a certain amount of improvements as evidence of good faith, and that this one thousand dollar requisite is for the same purpose. But the good faith required is not the same in each case. We want the settler to convince us that he intends to live upon the land, and so we require him to go there, put up a house and reside in it, so as to show that he really intends to perform the very thing we want him to do. Now, what is it we want the prospector to do? Simply this, to go out and hunt for mines, to get his titles in good shape, and then take them to money centers, and get capital to develop his claims. If he thinks it necessary, to make a good showing on his location, that he should expend one, two, or three thousand dollars worth of work upon it, he will do it if possible. If he has found a mine where it is not necessary, why compel him to do it? What good is done to anybody by requiring him to expend money when he is unable or unwilling to do so? The requirement does not compel him to abandon his claim, and let some one with more money come in and take it, for he can still keep up his title under district laws for a nominal sum. It merely prevents him from obtaining a patent by means of which, on account of the greater security of title it affords, he might get money to develop his claim. It also delays indefinitely the closing up of this part of the business of the Land Office, by necessitating the doling out of patents at a rate that would keep the office running for a thousand years, consuming the whole of the receipts from sales of this class of land in the mere routine of giving title. Why not adopt a free and vigorous policy, which would cause our vast mineral region to be quickly explored, thoroughly surveyed, carefully mapped, and voluminously reported upon by the thousand different experts that would be called upon to examine the various claims, thus in the quickest practicable time, and with the least possible expense to the government, shedding a flood of light over this vast and important region of our country, now so little known even to ourselves, to say nothing of the world at large. What if a few wrong-headed, obstinate men, here and there, attached undue importance to their claims, and kept them out of market for awhile, would not that evil be overbalanced a hundred times by the great impetus to investment such a policy would give?

NINTH.

Objection.—That the law does not provide for a uniform condition of tenure of possessory claims.

Amendment.—SEC. —. Possessory claims to mineral lands may be held from year to year, only by complying with the following conditions:

SEC. —. The owner or owners of any mining location existing on the first Monday of July, 1870, shall, within sixty days thereafter, under penalty of forfeiting said claims, file with the recorder of the district in which such claim is situated, and within like time cause to be recorded in his records, a description of the claim, which shall state:

1. The name of the claim.

2. The date of the location.

3. The number of feet claimed, and in what direction from the initial point on said claim.

4. The names of the original locators, when they can be ascertained from the records of the district.

5. A description of the place of location of the claim, together with the initial point of the claim, by reference to surrounding objects, which reference shall be sufficiently exact to enable a person of ordinary intelligence to find the premises from such description.

Sec. —. No location made on or after the first Monday of July, 1870, shall be valid, unless a description of said location, as above set forth, be filed and recorded, as above, within ten days after the date of said location.

Sec. —. The year of tenure shall, in all cases, be computed from the first Monday of July nearest to the date of location, and shall extend from and including said first Monday of July, up to and including the day immediately preceding the next following first Monday of July.

Sec. —. For the purpose of determining conditions of tenure, the term "possessory claim" shall be held to mean the whole area claimed for which a patent may issue, whether the same be held by one or more persons.

Sec. —. On every possessory claim of mineral land sought to be held from year to year, there shall be done for and during each tenure year, and upon the area claimed, an amount of work equal to twenty days' faithful labor of one man, or there shall be annually paid, instead of said work, the sum of one hundred dollars as license dues.

Sec. —. All moneys paid as license dues shall be paid to the United States internal revenue collector, or his deputy, for the district in which the mine is situated, and his receipt therefor shall be recorded in the records of the district, if such exist, and also in the public office of the person whose duty it is to keep the records of deeds of the county in which the mine is situated.

Sec. —. When work is done, instead of money paid, the recorder of the district, or his deputy, or if neither can act, or if they fail or decline to act, then the person whose duty it is to keep the record of deeds of the county, or his deputy, may measure and certify said work; and such certificate shall be recorded in the records of the district in which the mine is situated, if such records exist, and also in the public office of the person whose duty it is to keep the records of the deeds of the county in which the mine is situated.

Sec. —. All the said conditions must be complied with within ninety days after the date of posting the notice of location for new locations, and before the first Monday of October of each year for all other locations.

Sec. —. The performance of the said labor, or the payment of the said fees instead thereof, shall be the essential requisites for maintaining title, but the absence of the recordation prescribed shall be *prima facie* evidence of non-compliance with the essential requisites, and a relocation made in the absence of such recordation shall be good until proof of the performance of the essential requisites is made, and that reasonable diligence was made to obtain said recordation; and also until the relocator is reimbursed for his reasonable expenses in making such relocation.

Sec. —. A non-compliance with the essential requisites above described, shall work a forfeiture of the claim, and a claim so forfeited may be relocated with no other formalities than those required for an original location.

SEC. —. When any act, which by this act is required to be performed within a certain time, is not done within such time, but is subsequently performed in the interest of the party originally failing, and before any other person has taken advantage of such failure, such subsequent performance shall have the same force and effect as a performance thereof within the time prescribed.

TENTH.

Objection.—That there is no provision for the safe-keeping of district records.

Amendment.—SEC. —. District laws shall in all cases be recorded in the public office of the person whose duty it is to keep the records of the deeds of the county in which the greater portion of the district is situated.

SEC. —. Laws existing on the first Monday of July, 1870, shall be void, unless so recorded before the first Monday of October, 1870.

SEC. —. Codes for new districts shall not be valid, and no rights shall accrue under them, unless recorded in the public office of such custodian of deeds within ninety days after their adoption.

SEC. —. No amendment to any code, and no new code supplanting an old one made after the first Monday of July, 1870, shall take effect until thirty days after such amendment or such substituted code has been filed for record in the public office of such custodian of deeds, and a notice of such filing published in some newspaper (if any there be) published in the county in which the greater portion of the district affected thereby is situated.

ELEVENTH.

Objection.—That a distinction should be made between veins and simple deposits, and that the latter should be bounded by the area granted, and by vertical planes in depth.

Amendment.—SEC. —. All notices of application for patents shall state whether the claim is for a vein or a deposit, or both.

Protests may be filed against each claim by any person affected thereby, the same as by this act may be filed in cases of disputed title, and shall be disposed of in like manner with such protests.

SEC. —. When a patent issues for a deposit claim, the rights of the patentee shall be confined to the space granted, the area of which shall not exceed five hundred feet square, except in the case of patents for placer mines, river diggings, grant claims, and cement deposits: *Provided, however*, that the same principles of consolidation in obtaining patents in this act accorded to new locations, shall also extend to deposit claims.

NOTE.—I have drawn this section as to deposit claims because many are urging the need of such a provision, but I do not see the necessity of it. Every claimant is restricted to the space granted until he claims the right to go beyond it by reason of having a vein which extends beyond his boundaries and which he wishes to follow. It seems that that is the time to determine whether his claim as to the existence of a vein is well founded. There are workings then which will aid in the determination of the question. The course of the deposit is then bared to view, and until that is done no satisfactory determination can be had.

TWELFTH.

Objection.—That the law does not extend to placer claims, river diggings, &c.

Amendment.—SEC. —. The provisions of this act as to the issuance of patents for deposit claims shall apply to gold-mining claims of the kind generally known as placer mines, river diggings, grant claims, and cement deposits.

SEC. —. The rights of the patentee in such case shall be confined to the space granted, which may be of such form and extent of area as is allowed by the laws of the mining district in which said claim is situated, provided that the area of any such claim shall not exceed in extent an area equal to three thousand feet square.

THIRTEENTH.

Objection.—That the act does not provide a fund to assist in making surveys, and in founding a mining school.

Amendment.—Levy a bullion tax of one-eighth of one per cent. to be paid quarterly to the United States collector of the mineral land district in which the reduction works where the bullion is produced are situated.

SEC. —. All moneys paid to any collector of the United States for license fees and bullion tax shall be apportioned by him as follows: First, he may retain three per cent. of the same to his own use, which shall be his compensation for managing said fund. Second, he shall set aside fifty per cent. of the remainder for the benefit of the mining school fund of the State or Territory from whence said license fees were received, or which furnished the one from which the bullion was obtained which paid said bullion tax, and as soon as said State or Territory shall have authorized its treasurer to receive said moneys for said purpose, he shall pay the same to said treasurer quarterly, and thereafter said funds may be appropriated by said State or Territory for the establishment and maintenance of a mining school, either as an independent institution, or as an adjunct to any State or territorial educational institution already established, under such regulations as said State or Territory may prescribe. Third, the remaining fifty per cent. of said remainder of said fund he shall pay quarterly to the Treasurer of the United States, who shall place said moneys in a fund to be known as the National Mining School fund, and retain the same subject to the order of the Congress of the United States.

SEC. —. From time to time, sums which, with those already appropriated, do not exceed in total aggregate fifty per cent. of the total receipts of said fund, may be appropriated from said National Mining School fund to aid in making surveys of mineral lands.

NOTE.—For many years the revenue from the bullion tax will be much less than that from license fees. The producing mines should not object to the bullion tax because an amount in excess of what they pay will be devoted to mining schools which producing mines are interested in sustaining in order to have a large corps of experts to choose from to conduct their works. The poor miners will not object to the license tax, because they will get the benefit of the surveying fund without materially increasing the tax they now pay, from which they derive no benefit.

FOURTEENTH.

Objection.—Not preventing parties from floating a location originally placed upon a worthless claim to some other claim of greater value subsequently discovered.

Remark.—This is covered by the first section under title nine of these suggestions.

FIFTEENTH

Objection.—Allowing the register to publish the notice required for a patent at such cost to the claimant as the register and printer may choose to agree upon, instead of permitting the claimant to make his own bargain for such service.

Amendment.—In section three of the acts, change the words: "The register of the land office shall publish a notice of the same, &c.," so as to read "The register, &c., shall require satisfactory proof of the due publication of the same," &c.

SIXTEENTH.

Objection.—That the law does not prohibit the location of mere extensions, where no ore has been discovered.

Comments.—I do not concur in this objection for the reason set out in remarks under title eight, but I submit the following amendment as one that would cover the case if the objection is admitted:

SEC. —. No location shall be made until quartz or other rock in place bearing gold, silver, cinnabar, or copper has been discovered within the area claimed. The party making such discovery shall, for the period of thirty days immediately thereafter, have the exclusive right to locate the same.

CONCLUSION.

I have now gone through with all the recommendations in your report, and embodied them in the form of amendments, together with some suggestions which have been generally sanctioned in the regions where I have resided. I have found every step beset with difficulties. I suppose there is not a single amendment here proposed to which some one will not take some exception. Nothing will please me more than to have some one in such case propose other amendments which will give better satisfaction. If all persons interested will give the subject careful consideration, and forward their suggestions to you, much light may be thrown on the matter, and the congressional Committees on Mines and Mining will have abundant data to work upon.

I remain, respectfully, your obedient servant,

E. F. DUNNE.

R. W. RAYMOND, Esq.,
U. S. Commissioner of Mining, &c.

Adopting such of Judge Dunne's suggestions, and adding such of my own, as I think feasible at the present time, I have prepared the following draught of a bill on the subject, which I respectfully submit:

AN ACT to amend an act granting the right of way to ditch and canal owners over the public lands, and for other purposes, passed July 26, 1866.

SECTION 1. The tract granted by a patent covering a vein or lode, as described in section 2 of the act to which this act is amendatory, shall ot exceed two hundred and fifty feet in width on each side of the mid- e of the surface or outcrop of the said vein or lode, and the patent erefor shall grant the right also to all other veins or lodes within the id tract. When the grant of said two hundred and fifty feet would clude another claim, duly located prior to the —— day of ——, 70, the patent shall cover only half the width between the two claims; t claims located after the —— day of ——, 1870, shall not prevent e issuing of patent for the full width of the tract herein allowed: *ovided*, That the owners of adjoining claims, each of which is entitled a patent, may unite their claims and receive a single patent for a con- uous tract covering all the claims, and not exceeding in size the amount the tracts to which they would be separately entitled.

SEC. 2. Proof of due publication of notice of intention to apply for a tent furnished to the register of the land office shall be considered uivalent to the said publication by the register, as provided in section of the act to which this act is amendatory.

SEC. 3. Any person or association of persons claiming an alluvial posit, placer, gravel, or cement mine or digging, or an impregnation, gregation, or aggregation of ore irregular in form, and without defined alls or limits, containing gold, silver, cinnabar, or copper, and having mplied with the conditions expressed in sections 2 and 3 of the act to hich this act is amendatory, shall be entitled to a patent for the same, vering a tract not exceeding the area of —— feet, and granting the ght to all the minerals within the said tract, without the right to fol- w the mineral deposit into the land adjoining.

SEC. 4. Patents of the class described in the foregoing section may e granted for any kind of deposit of the said metals or their ores, on pplication of the proper claimants; but patents granting the right to llow the mineral into the land adjoining shall only be granted on claims which at least one vein or lode of quartz or other rock in place has een exposed, and only on the certificate of the mineral land surveyor ecuting the survey that the said vein or lode is so exposed: *Provided*, hat the proprietors of adjoining claims, or the applicants for patents hemselves, may, before the patent is issued, appeal from the decision f the mineral land surveyor as to the character of the deposit, and all roceedings shall be stayed until the question shall be decided by a ourt of competent jurisdiction, whether the said deposit is a vein or de within the reasonable meaning of the term, and the claimant is irly entitled to the right to follow it into the land adjoining.

SEC. 5. In order to establish the title of a claimant to any tract of ineral land for which a patent is asked, the following conditions shall e required: The record of location shall contain such a description of he claim by measurements from natural landmarks, or permanent onuments, that its precise locality may be at any time identified: *rovided*, That records of location made previous to the —— day of ——, 1870, may be amended to conform with this condition at any ime previous to the —— day of ——, 1871. Proof shall be furnished o the register of the land office that twenty-four days of faithful labor ave been performed upon the claim described in the record in each ear, subsequent to the date of location and before the —— day of ——, n each year, and the said proof shall consist of a certificate from the ecorder of deeds of the county, declaring that oath has been duly made n each year by the owner of a claim, or his or their authorized repre- entative, that the said labor has been performed: *Provided*, That, in eu of the performance of the said labor, it shall be lawful for the owner f any claim to pay to the United States revenue collector of the district, on or before the —— day of ——, in each year, the sum of ——, for the claim described in the record, and not exceeding the amount for which a patent may be granted; and in case of such payment the receipt of the collector shall be sufficient proof to the register of the land office: *And provided further*, That the failure to perform such labor or to make such payment in lieu thereof, shall not prevent the claimant from making good his title at any time for the purpose of obtaining a patent, by the payment of —— for each and every year of default, unless the claim shall have been located, recorded, and occupied by other parties during the time of such default. And, in general, every failure to comply with the conditions of this act shall prevent the party so failing to comply from interfering with the rights of other parties, accruing during the period of his default; but any such failure to comply with the conditions of this act may be made good by subsequent compliance therewith so far as the rights of other parties accruing during the period of such failure or default shall allow.

SEC. 6. The money received under this act by United States revenue collectors shall be appropriated as follows: —— per cent. to the collector for his services in collecting the same; one-half of the remainder to the State or territory within which the mining district is situated, as a fund for the maintenance of a mining school, or the execution of geological surveys, for which sum the receipt of the treasurer of the said State or Territory shall be sufficient voucher for the collector. The remainder shall go to the treasury of the United States, and shall be divided into two equal parts; one part to be called the national mining school fund, and devoted to the establishment and maintenance of a national school of mines; and the other part to be called the mining survey fund, and devoted to the promotion of the interests of the mining industry in equalizing the expense of surveys made necessary by this act and the act to which it is amendatory, and in such other ways as Congress shall determine.

SEC. 7. All acts or parts of acts inconsistent with this act are hereby repealed.

PART III.

MINERAL DEPOSITS.

MINERAL DEPOSITS.

CHAPTER LX.

CLASSIFICATION.

principal useful minerals obtained by mining are gold, silver, pla-
copper, lead, tin, quicksilver, zinc, antimony, bismuth, arsenic,
cobalt, iron, manganese, graphite, anthracite, pit-coal, lignite,
nous shale, peat, rock-salt, sulphur, alum-slate, barytes, gypsum,
e, precious stones, building-stones, and ice. The various liquid
l products, such as brine, petroleum, and mineral waters, should,
ıs, also be included.

term mineral deposits, though in common use, is not very happily
to define bodies of these useful minerals; for, on one hand, every
a mineral deposit, and, on the other hand, this name is frequently
l to a particular class of occurrences as distinguished from fissure-
I retain the phrase, however, in accordance with general usage.

f the minerals above enumerated are widely disseminated through
id crust of the earth. It is only those accumulations or concen-
ıs of them which can be practically utilized that receive this name
come the objects of mining.

eral deposits are classified according to their form, position, and
le origin. The first general distinction is made between exposed
erficial and inclosed or subterranean deposits. Superficial deposits
ise deposits of debris (alluvial or drift deposits formed of the accu-
d fragments of older rocks, such as gold and tin placers, gravel
ment mines, &c.) and surface deposits found *in situ*, (such as bog-
es, peat moors, salt, soda and saltpeter beds, and the coast depos-
amber. Occasionally a deposit originally inclosed is exposed by
ı of the overlying rocks, as, for instance, the vein of the Red
ain Company at Silver Peak, Nevada, which is a fissure-vein from
the hanging wall forming the side of a mountain has been almost
y carried away by disintegration and aqueous action. As this
ly justifies us in calling such a deposit a superficial one, so, on the
hand, a few feet of overlying soil does not convert a superficial
t into an inclosed one. The distinction, like others to be hereafter
ned, is broad and convenient, but not minutely accurate. Inclosed
terranean deposits comprise three great classes, distinguished,
ing to their form, as tabular or sheet deposits, mass deposits, and
lar segregations or aggregations. I must repeat that these dis-
ns are not sharply drawn and at all times to be recognized in
e. The degree to which they are founded in nature will be indi-
presently. Under sheet deposits are ranked such as possess two
ninant dimensions, while the third, called the thickness, is com-
vely small, so that we may speak of them as having a general
or sheet. It is also understood that the surfaces bounding such
sit on two sides have a general, though not mathematically exact,
lism; they constitute its walls or its roof and floor, according to
ition. The deposits of this class are divided, according to their

nature, into lodes or veins and beds. Mass deposits include both large, irregular masses of valuable minerals and strata of rock impregnated with valuable mineral or so intersected with a net-work of mineral veins that the whole must be extracted. The German word *Stockwerk*, applied to this class, and adopted by some American writers, means, literally, story, or story-work, and refers to the manner in which masses are exploited in successive stories, like those of a building. Irregular segregations or aggregations include nests, chambers, pockets, amygdules, and small ore-bodies of every description. They may occur in larger deposits of other classes. Thus, the amygdaloid beds of Lake Superior are sheet deposits, but their copper is often in segregations. Pockets and chambers are also common in veins, especially in large veins. The ordinary rock formations, worked by quarrying, and the springs, worked by boring, digging wells, and pumping, I leave out of consideration.

Recapitulating this classification of mineral deposits, we have:

A. Superficial deposits.

I. Deposits of debris.
II. Surface formations in place.

B. Inclosed deposits.

I. Sheet or tabular deposits.
  a. Lodes.
  b. Beds and seams.
II. Mass deposits.
  a. Masses.
  b. Impregnations, &c.
III. Other irregular deposits.
  a. Pockets, &c., distributed in other deposits.
  b. Isolated segregations, gash-veins, &c.

This is substantially the classification of Lottner, a late distinguished professor at the Berlin School of Mines. In the small space devoted to this discussion I can only make brief mention of the most important of the above classes, adducing at the same time established American examples, and confining myself principally to the bearings of the subject upon gold and silver mining.

CHAPTER LXI.

SUPERFICIAL DEPOSITS.

These are always of comparatively recent geological formation. The deposits of debris are accumulations of mineral detached from its original localities by disintegrating influences, and conveyed, generally by water, to a new position. They contain, therefore, a great variety of material, from large boulders down to the finest sand or clay, in which the valuable minerals are imbedded. Sometimes these deposits are simply disintegrated—not washed away. They are then to be recognized by their freedom from water-worn particles, sand, &c., their general homogeneous composition, and their position in places where there are otherwise no signs of alluvial action. The most frequent superficial deposits of debris, however, have been accumulated by currents of water. The lighter minerals have been washed away, including all those ores which, by chemical decomposition, assumed forms of all specific gravity, or actually became soluble. Hence it is not com-on to find pyrites, silver ores, or carbonates in placers, though the iginal deposits may have contained all these in great abundance. We id, on the other hand, principally gold, platinum, heavy tin ore, mag-tic iron ore, specular iron, and precious stones—all substances which mbine high specific gravity with indifference to ordinary atmospheric gencies. The process which such deposits have undergone may be lled a natural "dressing," or mechanical concentration. As in artifi-al concentration, so in this case, the size and shape of particles has so an influence upon their deposition, as may be seen in the stratified rangement of sand, gravel, and boulders in any river bed. After such deposit has accumulated, the passage through it of siliceous or calcif-rous waters, together with the pressure of new accumulations above, ay cement it together in a solid mass, so that it can only be extracted y blasting, as if it were solid rock. California, Oregon, Idaho, Montana, nd other Pacific Territories give abundant examples of every form of lacer deposit, including gravel and cement. The celebrated blue lead f California is the most notable instance of the latter. It is in an an-ient river channel or system of river channels, running, in many cases, cross the present streams, and now overlain with alluvium, or even ith eruptive masses and hill ranges. The blue cement is rich in gold, but the numerous boulders of all sizes contained in it appear to be bar-ren. The deposits along the banks and in the channels of present treams are doubtless still in the process of formation. Indeed, it is fre-quently the case that mining operations on the upper waters of a stream ill cause in a year or two profitable placers on the bars and bends be-ow. Artificial placers of this kind may be seen in almost any extensive lacer region, as, for instance, on the Carson River, below the mills of Vir-inia, where tailings of considerable value have sometimes been gathered. is an interesting question whether gold accumulated in placers increases the size of its particles. The idea has been scouted by some scientific riters, but there are strong indications that such a process actually takes ace. The greater purity and size of nuggets, &c., found in placers, as mpared with the veins from which they were formed, indicates an aggre-tion or inorganic growth, preceded by a chemical reaction, removing lver and baser metals. Genth,* in 1859, concluded from the superior rity of the alluvial gold of the southern States, that the veins could t, by their decomposition, have furnished it; but Oscar Lieber† had al-ady put forward a bold theory of the alteration of the gold by solution, ecipitation, and agglomeration, which he supported with ingenuity, it received mostly ridicule for his pains. At that time the chemical ssibilities were not fully known. Professor Bischoff, the eminent emist and geologist, has since found that sulphide of gold is slightly luble in pure water. It is now also known that chloride of gold will exist, in very dilute solutions, with protosalts of iron, provided ere is present an alkaline carbonate and a large excess of carbonic id. If the sulphide of gold is required in solution, it is only neces-ry to charge the solution with an excess of sulphuretted hydrogen. the same connection should be mentioned the discovery, from a dif-rent quarter, that metallic gold is soluble in solutions of the persalts iron. It will be seen that these discoveries give a much larger range d greater probability of changes in the auriferous material once de-sited in a vein.

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[*] American Journal of Science and Arts. September, 1859.

[†] Der Itacolumit, seine Begleiter und die Metallführung desselben, von O. Lieber, aatsgeolog von Süd-Carolina. In Cotta's Gangstudien, Freiberg, 1860.

But another and still more important series of experiments has been carried out by Australian chemists, and corroborated, I believe, in France. The latest reported results of these inquiries are found in a paper on the formation of gold nuggets in the auriferous drifts, read before the Royal Society of Victoria, by Mr. Cosmo Newberry.* The arguments and facts contained in that paper strongly support the theory of the growth of nuggets, and furnish a simple analogy in the precipitation of metallic gold from solution by the reducing action of organic matter, in the presence of a nucleus. The nucleus may be itself gold, or iron, copper, or arsenical pyrites, galena, zinc blende, or sulphide of antimony, &c., and upon it the metallic gold collects in irregular grains, accumulating in mamillary and even crystalline forms. This being the case in the experiments by which artificial nuggets and crystals of gold have been produced, we are led to believe a similar process possible in nature, especially since nuggets of drift-gold, when weighed, show frequently a less specific gravity than belongs to the metal; and, when sawn in halves, display, in numerous instances, the oxidized remains of former nuclei.

To some such process of solution and deposition we may ascribe the presence of gold in rocks and veins; its alteration and reduction to metallic form ("free gold") in the upper or exposed parts of such rocks or veins; and, finally, the still greater purity and size of its particles so frequently noticed in placers. As Lieber very forcibly remarked, if we are forced to believe in the reduction and molecular aggregation of gold above the water-line in veins, we must expect the same process to be still more likely in placers, which are more exposed to atmospheric agencies and percolating waters. It is not necessary to assume, however, that this process takes place in all cases. On the contrary, certain chemical reactions being involved, there must be certain coincident conditions. These I cannot here pause to discuss elaborately. I shall return to the subject in considering the distribution of gold in veins, and I will only add at present that this theory affords the only rational explanation of the influence of eruptive rocks upon auriferous deposits. Humboldt, Murchison, and many other observers, have noticed the prevalence of eruptive masses in or near gold-bearing deposits, and many hypotheses have ascribed to these sources the introduction of the gold. The true connection between eruptive rocks and mineral deposits of gold, and several other metals, is to be sought in the abundance of thermal and saline waters accompanying and succeeding such eruptions. There is in most cases no reason to suppose that the metals themselves formed part of the eruptive mass. Lavas and traps are in general notably free from the metals concentrated in neighboring deposits.

To return to the subject of alluvial deposits, it must be confessed that the mechanical processes of deposition are by far the most universal and influential in such formations. As already remarked, superficial deposits sometimes occupy the precise locality of the rocks from which they are produced; as, for instance, numerous gold-diggings in the southern and Pacific States on the very outcrops of auriferous veins. These, not having undergone to any extent the processes of mechanical concentration and accumulation, are not so rich as the placers of accumulation. Cotta† lays down the following rules, deduced *a priori* from the method of formation, and confirmed in practice:

1. Placers *in loco* will be likely to carry metals in quantity and distribution like the original deposits on which they lie.

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* American Journal of Mining, September 12, 1868.

† Erzlagerstättenlehre, Bd. I, S. 101, 102.

2. Alluvial placers of accumulation will be richest in those places where the current of the stream was interrupted by a diminution in its fall, by sudden change of direction, or by the entrance of a tributary; I would add, also, by reefs, bars, and eddies.) The absolute richness, however, depends upon local circumstances, and the size and weight of the floated masses must be taken into consideration.

3. Especially rich are frequently, of course, the small depressions, holes, creases, and fissures of the bed-rock over which the current passed.

4. The lowest layers of each period of deposition* are usually the richest.

5. Sometimes, however, several periods of deposition have succeeded each other; and thus several rich strata may occur in the same ground.

6. Not only the courses of present streams, but also, and especially, the ancient channels, now forsaken, are the localities of placers.

Of these rules, the fourth and fifth especially deserve attention. A period of deposition may be understood as the time during which all the mass of alluvial material is sensitive to the action of water. By the gradual cementing process already alluded to, or by an interruption of the aqueous action, the alluvial layers may become so hardened as to form a new bed-rock; or, simply by great accumulated depth, they may cease to be affected to the bottom by the action of the stream. The result would be, if the deposition of material continued, a second series overlying the first, and having its own relative degrees of richness in different strata. The miners of the Pacific Coast have learned by experience that there are frequently two or three bed-rocks, and corresponding strata of maximum richness, alternating with others more or less barren. Many old diggings, supposed to have been exhausted, will undoubtedly be worked again with deeper bed-rock tunnels, and will yield more gold than ever. A striking instance may be found at Dutch Flat, n California.†

Gold, tin, platinum, magnetic iron, and precious stones are the principal valuable minerals occurring in placers. Tin placers have not yet been discovered in this country, except the stream-tin from southwestern Idaho, the specimens of which are promising, but the quanity available is not known. The vast deposits of Banca and Malacca, in he East Indies, are alluvial, though, I believe, to some extent covered. The platinum-placers are mainly in the eastern Ural. This metal, as well as iridium and osmium, has been found with American gold; but ur prospectors have as yet (possibly from lack of familiarity with platinum. and possibly from not searching particularly for it) reported no locality where it might be obtained. In view of the great usefulness of his metal in the arts—limited only by the small supply and high price—he importance of finding it in this country in paying quantity is evident. Placers of copper occur in China and Brazil, and I know of one locality in Nova Scotia, on the coast of the Bay of Fundy, where this metal, in crysals of pea-size, imbedded in clay, can be mined with the shovel. Arificial placers of iron ore occur on the coast of Elba,‡ where are accumuated the debris washed down from the burrows of vast, open cuts made by the iron-miners on the mountains. Still more striking instances re furnished by the magnetic and titaniferous iron-sands of Canada and New England, and of New Zealand. The latter have been shipped to

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* In the original, Schwemmperiode.

† See my report for 1868, p. 32

‡ Karsten's Archives of Mining, Bd. xv, S. 410, cited in Gaetzschmann's Auf-und Unrsuchung, (Freiberg, 1856,) p. 220.

England, with indifferent pecuniary and metallurgical success. The iron-sands of Canada are now worked with success at Moisie;[*] and the recent introduction of machines which separate the ore by means of magnets very rapidly and cheaply will doubtless result in a wide development of these deposits. Dr. T. Sterry Hunt recommends experiments with placers of this nature existing along the coast of Long Island Sound.

Returning once more to gold deposits, it should be remarked that, from the nature of their formation, placers are generally, in their richest parts, much richer, by virtue of the concentration they have undergone, than the strata or veins from which they are formed. The possible aggregation of particles to nuggets larger than the masses found *in situ* has already been noticed.[†] But, under some circumstances, the veins may be richer than the resulting placers, as, for instance, when the original rock is so hard as to resist in a higher degree than the country rock the disintegrating influences, so that for every small portion of auriferous material detached an immense quantity of the baser debris is carried away in the same streams; or, where the peculiar arrangement of water courses is such as to scatter, instead of concentrating, the auriferous material. But these instances are rare. On the other hand, the amount of material to be extracted and treated for obtaining a given quantity of gold is generally much greater in placer than in vein mining. The removal of poor or barren strata, the search after the richer accumulations, and the vast amount of excavation required for ditches, &c., are heavy items; and it must be remembered that the capital thus invested must pay for itself in a short time or become a total loss. The average economical results of all the placer mining, compared with those of all the quartz mining for gold for the last twenty years in this country, would, I think, show a balance in favor of the latter.

The second class of superficial deposits is represented by beds of bog-iron ore, salt, soda, sulphur, &c. Salt and soda beds are common in the great inland basin of this country. They belong to the same category as the salt lakes, borax lake, &c. The great prevalence of alkaline deposits in those regions is due to the decomposition of a soda feldspar in which the porphyritic and trachytic rocks abound, and which is the first ingredient removed from them by heated waters or atmospheric agencies.

The source of the alkaline salts in all these lakes and marshes seems to be the hills around them and not the ground beneath. Thus the great salt field at Silver Peak, which covers with its snowy surface nearly fifty square miles, is but a few inches or feet in depth, and hot and cold springs of fresh water come through it to the surface. Fresh

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[*] Engineering and Mining Journal, February 5, 1870.

[†] The following are some of the largest nuggets reported:

		Troy weight.
1730,	La Paz, Peru	60 lbs.
1838,	Cabarras County, North Carolina	28 lbs.
(?)	Reid Mine, North Carolina	80 lbs.
1842,	Ural Mountains	97 lbs.
(?)	Australia	146 lbs. 3 dwt.
1851,	Australia	112 lbs.
1851,	Australia	106 lbs.
(?)	Australia, (the "Sarah Sands,")	223 lbs. 4 oz.
1853,	Ballarat	168 lbs.
(?)	California	160 lbs.
1869,	Australia	112 lbs.
1869,	Sierra County, California	106 lbs.

Solid masses of such sizes have never, so far as I know, been discovered in veins.

water can in many other places be found by digging in the salt fields. remember one instance at Lone Mountain, Nye County, Nevada; but he water, though not actually salt, is not pure. The hot spring in he Silver Peak marsh appears to contain a good deal of lime. The manner of working these salt beds is described in my last report.*

There is a remarkable deposit of soda about two miles north of the Sand Springs road, and fifty miles east of Virginia and Gold Hill. It is owned by parties in Carson and Virginia who use it in the manufacture of soap and supply quartz mills with it as a chemical agent in the reduction of ores. They also furnish it to drug and grocery stores, where it is sold for washing and other purposes for which common soda is ordinarily used. It is said to be free from all earthy matter and to consist of 80 per cent. soda, the balance being other salts. The deposit is in the midst of an alkali flat of some seventeen acres in extent, and at the surface it appeared only about three feet wide, or more like a soda spring than anything else, the pure article forming in a crust over and about the strong watery solution. Upon digging beneath this, however, the solid soda was discovered in a defined mass. A shaft has been sunk beside it to the depth of fifty feet, from the bottom of which a drift has been made twenty-five feet into the vein or deposit of soda, without getting through it. The inclosing walls on each side are very distinctly defined, and are simply composed of a dark, heavy, compact iron sand, strongly impregnated with soda. Analogous deposits in Humboldt County, Nevada, have furnished excellent fluxes for smelting refractory ores.

CHAPTER LXII.

INCLOSED DEPOSITS.

Lodes constitute the first subdivision of the inclosed deposits. A ode is a fissure in the earth's crust, filled with mineral. The terms vein, lead, ledge, and reef, are used indifferently for the same thing; but all these terms are frequently applied vaguely or incorrectly to sheet-deposits, which are not lodes. Thus we hear of veins of coal; and, in the common usage of miners, everything is a "ledge" which has been "located." The distinction between lodes and beds is, however, really the sharpest and most positive in this whole classification. All odes are fissure-lodes, even those running parallel with the stratification of the inclosing rocks, or occurring along the contact of two different rock-formations. The definition above given includes these cases, as I shall show more clearly by considering the radical distinction between lodes and beds. The latter are generally (but not always exactly) parallel with the inclosing rocks, and amount to nothing more, in most cases, than layers of the regular formation, differing in their contents more or less from the earlier layers under them and the later layers over them. In some instances the parallelism is only general. The beds widen and thin out, and on that account are sometimes held to be lodes, especially if steeply tilted. But this irregularity is common enough in all stratified rocks. The test question deciding between a ode and a bed turns on the definition already given. A bed never is, and a lode always is, a deposit effected between already existing rocks, and, therefore, of later origin than the strata on either side; in other words, a fissure filled. The fissure may be across the stratification or parallel with it, or along the contact-plane of two formations; it may have been filled in any one of many ways. These all give rise to different varieties of veins; but the general definition includes all, and is as clear as it is broad. We have then, at the outset, the following conclusions from our definition:

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* Mineral Resources, &c., 1869, page 81.

1. The form and direction of a vein are determined by the fissure.

2. The mineral contents are determined by the time, manner, and material of the filling of the fissure.

3. The vein-material is always later than that of the formation of the "country" or inclosing rocks.

4. Sheet-deposits, intersecting a formation across the stratification, and independently of it, are certainly lodes; but all lodes need not necessarily take that direction.

5. Lodes parallel with the stratification are not so easily recognized: because they may be confounded with beds; but when they are proved to consist of material later in origin than the rocks on either side, and deposited in a seam or opening between them, whatever be its direction or dimensions, they must be considered lodes; and the same is true of "contact" lodes.

6. There are, however, contact beds, namely, layers between two formations, differing from both, but formed in the regular series of time as well as position, to which both belong. These are not lodes.

The advantage of definitions is shown in the practical conclusions which may be drawn from the foregoing simple statements, and which I insert here, to show that they are independent of all the complicated hypotheses which surround this subject. No matter what theories are entertained as to how a fissure is formed, or how filled, I think the following conclusions cannot be escaped:

The history of a lode comprises logically three epochs: the forming of the fissure, determining its form; the filling of the fissure, determining its substance; and the epoch of modification, affecting both. In fact, however, two or more of these processes may go on at the same time. Logically, the fissure must be formed first; but in cases of volcanic dikes, the filling is practically simultaneous with the fissuring, and impelled by the same force. Again, changes in the form and substance of a lode do doubtless take place during, as well as after, its formation. The third epoch is added, however, to represent the realm in which modifying agencies rule supreme.

I waive at present the question how fissures are formed. It is certain that in most cases they are not immediately filled; and it is highly probable that the process of filling occupies considerable periods of time, during which the fissure remains open. Now the natural tendency of an empty fissure, unless it be perfectly vertical, is to close again, by reason of the unsupported weight of the upper side, fitly called, in miners' phrase, the "hanging wall." My observation convinces me that a great number of fissures do close in this way, and never become veins at all, but remain visible, if visible at all, only as "seams," "lines of fracture," "breaks," or "slides," having almost no filling, except clay produced by the abrasion of the rocks on either side with moisture. It is evident that for the complete formation of a lode there must be a fissure, and this fissure must be kept open till it has been filled with fresh mineral.

The same cause which tends directly to close fissures, tends indirectly to keep them open. I mean the weight of the hanging wall. Pieces of *rock* detach themselves from this wall and fall into the fissure, where they become wedged, and thus hold the sides apart. These pieces, when they are afterward found imbedded in the vein matter, are called "horses." Another way by which the fissure may be kept open is by the settling back of the hanging wall, not exactly to the same place which it occupied before. In this way the surfaces of the two walls, instead of fitting each other, meet at projecting points or bulges, and leave a fissure of alternately widening and narrowing form. A simple experiment with two plates of corrugated iron will show this effect to the unprofessional reader. It must be remembered, however, that the original irregularity of fissures, and the frequently oblique or even compound motion of the wall in settling back, tend to produce departures from the simple type indicated by the above experiment. A closer analogy may be obtained by cracking open a cobble-stone, and bringing the parts together again in new positions. In this way the characteristic features of form in lodes (apart from slides and heaves, to be explained hereafter) may be produced in miniature.

The form of a fissure depends then upon the original forces producing it, and its subsequent modifications, principally through the movement of its walls. We cannot lay down general laws governing all lodes in these respects; but we can discover in single lodes and groups of lodes [illegible]ts of local processes, and thus arrive at rules more or less appli[illegible] those particular cases. That the contents of a vein have com[illegible]ly little to do with its form, is evident from the foregoing dis[illegible]on. The fissure is a mold, into which the vein material is run, and the effects of that material upon its mold are comparatively insignificant. The theory,* advanced upon distinguished authority, that fissures are generally widened by the force of the crystallization of their fluid contents, is, I think, wholly without foundation. If filled with melted matter, they are more likely to shrink; if with matter in solution, the deposition of crystals is gradual, and the space is rarely so confined as to give opportunity for a force to act against the walls. The very last deposit, down the central line of the vein, might crystallize under some confinement; but it is preposterous to ascribe to it any perceptible movement of the walls. The expansive force of crystallization, as indicated in the freezing of water, is very great; but it does not come into play in the quiet deposition of crystals from solution. Nobody ever saw a geode, burst open by the crystallizing of its infiltrations; yet we are asked to believe that vast weights have been moved considerable distances by such action in spaces comparatively still more insignificant. All the facts observed, moreover, such as the occurrence of "selvages," "vuggs," or empty spaces, "slickensides," &c., agree with the hypothesis of pressure from the walls, tending to close the fissure.

Fissures are limited in length, and it is impossible to tell how far they continue, except by actual exploration. Their extent in depth is equally unknown; but well-defined fissures have been thus far found to continue in depth further than human skill is able to follow them. To conclude, however, that because they descend more than one or two thousand feet, therefore they continue to the center of the earth, or to the supposed fluid mass, calculated to be from twenty-five to one hundred miles below the surface, is manifestly unreasonable. With the exception of superficial and gash-veins, (see below,) we may consider them as practically inexhaustible in depth, without assuming to say how far they go. With our present appliances, our operations are limited by the difficulty and cost of deep workings, not by the extent of the fissure in that direction.

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* See my report of last year, p. 39, note.

The question, how fissures are filled, is also waived for the present. It must be admitted that the filling is generally a subsequent process, and there is no reason why it should not take place very slowly, through unmeasured periods of time. The changes that accompany and succeed it are those of position, (cross-fissures, of later formation, dislocating the vein, or fresh movements of the walls of the vein itself,) and those of composition, (oxidation, and other chemical changes, galvanic currents, molecular movements, concentrations, redistributions, &c.) No doubt the form of the fissure influences the distribution of the vein-material, especially when the latter contains substances of different gravity, solubility, or volatility. For instance, vein-matter in solution or mechanical suspension would be more likely to be precipitated in wider parts of the vein, where the current would be slower. But these considerations are too nearly connected with most theories of vein-formation for my present purpose. I will only add one observation with regard to vein-material, which, like the foregoing, will, I think, meet with general acceptance; and then I shall proceed to deduce from the indisputable premises thus far established, a few practical conclusions, calculated, I think, to sweep away from the field of inquiry a great deal of unnecessary rubbish.

Nature has not regulated her operations by commercial rules. To her the distinction between valuable and useless minerals, rich and poor ore, is unknown. Many fissures are filled with granite, porphyry, basalt, &c., and are of no interest to the miner, except so far as they produce disturbances of ore-deposits. Of those fissures which are filled with metalliferous material, some are rich enough to pay for working, and some are not. The same vein is in one spot rich, and in another poor. These variations it is impossible to reduce to any general law, especially in the case of gold and silver. The former of these is always, and the latter frequently, an accidental constituent in the vein-material. One-thousandth of one per cent. of gold would correspond with $5 gold per ton of ore—scarcely a paying quantity; two-thousandths of one per cent. would be $10 per ton—enough, under favorable circumstances, to pay good profits. One-twentieth of one per cent. of silver would be about $19 per ton—too low for profit at any but the Comstock mines; and reducing this by one-fiftieth of one per cent. makes it economically worthless. It is manifest that changes so small as these cannot have the importance naturally which we assign to them commercially, and that we are not likely, for instance, to find out by what law the proportion of gold varies from one to two-thousandths per cent, crossing the arbitrary line of profit, which we, and not nature, have drawn.

The practical conclusions to be deduced from the foregoing remarks concern several theories and sweeping assertions popularly current with regard to mineral lodes.

1. It is said that "fissure veins" increase in width with increase of depth. This is evidently, in view of the foregoing discussion, unfounded as a general proposition. The width of a vein depends, first, on the original fissure, and the width of that is a function of circumstances, unknown and various. A force, for instance, pressing vertically upward until the crust is fractured, may make a fissure wider at the top than anywhere else, while a fissure produced by settling may be wider at the bottom. The width of a vein depends also on the degree to which a fissure closes, before and during the entrance of vein-matter. This, again, directly depends on the dip, on the occurrence of "horses," and on the speed and uniformity with which the vein-matter is deposited. Finally, the width of a vein depends on those movements of the walls which pro-

ce alternate wide and narrow zones or spots in the fissure. Now all ese operative causes, though they may be partially investigated in a igle given case, cannot be reduced to a general law; hence, *a priori*, ere can be no general law that fissures grow either wider or narrower depth. Experience signally corroborates this conclusion, showing at while veins of the same limited district may have a similarity of aracter in these respects, there is no uniformity that covers large gions, or different conditions. But an argument that cannot be aded is deduced from the fact that we have no standard of depth. I ive frequently heard miners discussing whether their veins would give out" at, say, six hundred feet, while the whole surface on which e veins cropped out had been so enormously degraded by denudation to be already five thousand feet below the original level up to which e veins possibly extended. Until we can decide how wide was that rtion of a vein which floods and glaciers and the slow work of time ive swept away, we cannot very well attempt to argue that, because it a vein, it must or must not widen as we sink our puny depths upon it.

2. It is said that fissure-veins grow richer in depth. But it is evi- nt that this cannot be laid down as a general law. As I have shown, e variations which make a vein, according to our ideas, rich or poor, e frequently quite insignificant in intrinsic amount. The deposition metalliferous matter in veins depends on the source from which they filled, the manner and duration of the process, and the subsequent tamorphosis they may have undergone. The depth of any point low the present surface concerns only the last condition. Decompo- ion from atmospheric or meteoric agencies (a term which includes the ion of air and surface waters) may alter a vein to a considerable pth. Where the valuable contents are soluble or easily decomposed, may impoverish the vein. When they are insoluble and not easily acked, the vein may be richer near the surface by the removal of n-valuable material. A probable connection in some cases between lth of fissure and richness of deposits has been indicated above; but far as this or any other cause is concerned, we cannot argue anything m the present surface, which is, in numerous localities, itself a section the vein at great depth. Experience confirms this view, showing t some veins are poor at the outcrop, and richer below, while ers show the reverse. We may fairly say that the valuable constit- nts of the ore (especially gold, and to a great extent silver also) vary ording to local causes, and that lodes, as they are followed down- rd, are alternately richer and poorer—the accidental present surface the country (meteoric action apart) being merely a section, crossing netimes a wide, sometimes a narrow, sometimes a rich, sometimes a or place. It does not follow that a rich outcrop will be followed im- diately in depth by a poor vein, or *vice versa*, for the scale on which se alternations take place is variable, and frequently exceeds that of r mining operations. Besides, the terms rich and poor in this con- ction are merely relative to each other, and to each special case. The hest part of a vein may be too poor to work with profit, or the poorest rt may pay handsomely. Rich ore in White Pine contains a hundred es as much silver as ore considered rich in Japan. The statement t forward on very high authority,[*] though based on incomplete obser- tions, that gold-veins cease to carry gold at comparatively small pths, is now completely overthrown by experience. Mr. J. Arthur illips[†] speaks the opinion now universally acknowledged, that gold

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[*] Murchison, Lieber, and others.

[†] Mining and Metallurgy of Gold and Silver. London, 1867. p. 9.

ledges are not more liable than ordinary metalliferous veins to become impoverished in depth. What becomes then of the former observations to the contrary? In some cases, no doubt, a mere alternation or barren zone in the vein was mistaken for a complete cessation of the auriferous character. In other cases, no doubt, there was a total change in the vein material. That such changes do take place, admits of no doubt. The mistake was in believing them to be universal and inevitable, and to have some direct connection with gold.

3. It is said that certain directions of course in veins have a decisive influence upon their metalliferous character. As the formation of the fissure takes place before its filling, this theory is *a priori* illogical. Experience equally condemns it, and indicates the true meaning of the supposed connection. It is true that, in limited districts, veins having a certain general course are frequently found to correspond in mineralogical character; but this is due to the nature of the process which opened the group of parallel fissures. The fissures of a certain epoch being sometimes parallel, and the same causes having filled them all, the resulting veins of that system or group may, in such a case, be quite similar; but it is the age, and not the direction, of the veins which effects this result. Sometimes groups of fissures of the same age are not parallel, but radiate from a common center. In that case the significance of the course of a vein is nothing. Not infrequently the same group of veins possesses all the courses of the compass, and forms a complete network of intersecting fissures, so that even the local analogies of course have no weight. As for the sweeping theories, based on observations in one country or district, and boldly extended to all others, they are ridiculously absurd. I know of one instance in which a distinguished foreign engineer condemned without inspection a very productive gold mine, as soon as he heard what was the strike of the vein—so far can prejudice or fancy warp the judgments of even educated men! The only general reason ever advanced for supposing veins of a particular direction to be richer than others, is a wild, vague theory of the influence of terrestrial magnetic currents, which will not bear inspection.[*]

4. It is said that certain features of direction or shape are peculiar to gold veins; certain others to silver, &c. There are many different theories involving assumptions of this kind. But I have sufficiently shown that the form, direction, and extent of a fissure are not, as a general rule, essentially affected by the nature of the material with which it is subsequently filled; nor, if this effect were produced, would it be the infinitesimal proportion of gold or silver, but rather the predominating quartz, or iron pyrites, or galena, from which the influence would chiefly proceed. Many things are in fact predicated of gold deposits which belong simply to the accompanying iron pyrites; and many a returned Californian has discovered in the rusty boulders of his native village "all the indications" of a rich gold quartz.

5. In a word, there are in this sense no universal laws governing the dimensions, directions, changes, and metalliferous contents of veins. Every system or group, and, to some extent, every vein is a problem by itself. As I shall now proceed to show, we have discovered many different agencies more or less operative in such formations, and the degree to which each has influenced the result can only be determined, if at all, by patient observation of each special case. Every actively-engaged

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[*] It is put forth in a book called, I think, *Geology and Magnetism*, by Mr. Hopkins, an English mining engineer—a curious compound of careful and accurate observation in small local details, with loose generalization and disregard of scientific truths on the great scale.

nining engineer ought to have a theory of the formation of the vein he s working, or at least such a knowledge of it as will enable him, after ufficient developments, to forecast with considerable certainty the re-ults of future work. This can only be attained by carefully collating nd preserving all observations made during the progress of the work. Not a change in the vein or country-rock, not a watercourse, seam, or orse should fail to be noted and recorded. Maps of workings, contain-ng such information as this, are of the greatest importance; but I regret to say that those persons who are most ready with universal theories are too frequently the most neglectful of concrete facts. On the other hand, a large class of mining experts, believing that "nobody can see into the rock further than he can put a pick in," despise the whole science of mineral veins, and arrange their plans wholly according to the ore in sight. No doubt this is a more conservative plan. The engineers who follow it seldom get their clients into trouble by over-sanguine prophecies; but I think they frequently condemn good mines, and in this way occasion loss to owners. Of a new discovery, in a new locality, the less that is prophesied the better; but intelligent experts ought to be ashamed not to know something more definite about the nature, extent, and value of a mine after it has been developed by actual working. I refer particularly to those in charge, who have had the opportunity to bserve, as operations proceeded, all the facts throwing light on these oints. When drifts are timbered, stopes filled up or caved, and all fresh xposures altered by time, it is often too late to repair former neglect, nd the best observer may be deceived or find himself at a loss.

The effect of the foregoing considerations should be to discourage all ere theorizing as a basis for practice, and to encourage the most minute nd careful study of local occurrences. The absence of accurate sur-eys, working maps, and detailed records of operations, in most Ameri-an mines, even the best and oldest, has led to great waste of money ready, and, if it continues, will be still more disastrously felt hereafter.

I cannot undertake, in the limits of this introductory chapter, to dis-uss at length the different theories of the formation, modification, and ling of fissures. It must suffice to enumerate the most prominent, and rhaps to indicate their relative importance. One of the most compre-nsive and trustworthy works on the subject* has just been translated nd republished in this country; and I recommend its careful study to l persons who desire to obtain rational views concerning a matter so uch befogged with crude speculations.

The most universal cause of fissures is doubtless plutonic agency, heaving portions of the solid crust. This is indicated by the fact at veins are most numerous in mountainous regions. The German rm for a mine is bergwerk, or mountain work. Again, it is very com-on to find masses of eruptive rock in the neighborhood of ore veins; nd although these masses can but rarely be supposed to have directly ought the metallic material into the veins, it is natural to conclude at their occurrence is connected with the disturbances which formed e fissures. Under plutonic agency must, however, in this sense, be cluded all subterranean disturbances—depressions as well as upheavals, nd flexures and latitudinal compressions of strata as well as direct actures. These may be indirect and slow consequences of changes in e solid crust. It is not necessary to believe that fissures are always rmed by sudden convulsions. Indeed, modern geologists are inclined to ascribe many appearances which seem at first glance to result from violent action, to slow and long continued processes. The strata of coal and rock in coal mines have been observed to become contorted and fractured in a few years by the simple removal of supporting masses from below.*

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*Cotta's Erzlagerstättenlehre, (A Treatise on Ore Deposits,) by Bernhard von Cotta, ofessor of geology in the Royal School of Mines, Freiburg, Saxony. Translated by ederick Prime, Jr., mining engineer, and revised by the author. New York, 1870.

Fissures may also be formed by the contraction of rocks in cooling; but the importance of this agency has probably been overestimated, so far as metalliferous veins are concerned. Many crystalline rocks have been reckoned as igneous, or supposed to have been subjected to a degree of heat rendering them semi-fluid, which are now quite generally admitted to have been metamorphosed by less violent agency. The fissures formed by cooling in unmistakably eruptive rocks are, on the other hand, generally unlike those of metalliferous veins. During the past two years I have had opportunity to study this class of phenomena throughout the vast regions of California, Oregon, and Idaho, which are covered with basaltic overflows; and I cannot see how the process of contraction could in any case produce long, regular, and deep-seated fissures. The cooling and crystallization of basalt seems to take place around central points or lines. Possibly the first tendency is to the formation of cylindrical masses; and these are finally fixed in irregular prisms (principally hexagonal) by the weight and tension of the whole mass. The formation of the round cell of the bee, and its subsequent adaptation by pressure to the hexagonal form, would be a parallel case. At all events the process of cooling cannot be uniform over a large surface, and especially not at different depths. Fissures formed in this way, therefore, would not be persistent in direction, nor would they extend in depth below the stratum, the whole of which was at one time cooling. Gash-veins, which do not extend below the stratum in which they are found, are therefore more likely than any others to be the result of such a process; but even these, I conceive, are far more frequently produced by bending of the strata, and consequent fracture of the layers under the heaviest strain.

The theory of Fox, promulgated some thirty years ago, ascribes the formation of fissures to electrical currents. Experiments showed that by means of artificial currents fissures could be produced in clay and also filled with metalliferous deposits. One deduction from this theory was the assertion that all metalliferous veins ought to cross the magnetic meridian at right angles. The fact that veins do not behave as they "ought," in this respect, would of itself overthrow this generalization; but it is also completely disproved by modern investigation of terrestrial magnetism and electricity. Galvanic currents between dissimilar rocks, constituting natural voltaic piles, pay no particular respect to the magnetic meridian; and all such agencies, though possibly universally active, are too dependent upon the minute local conditions, and too certain to be locally disturbed, to produce widely uniform results. Galvanic action in veins, *after the deposition of the metalliferous matter*, is probably very important; but the direct effect of galvanism or electricity or terrestrial magnetism in forming or in filling fissures is probably insignificant.

Finally fissures may be formed by surface agencies, such as frost, running water, glaciers, (combining both,) the penetrating roots of plants, (following and assisting the former,) and consequent land-slides, &c. I have seen a fissure several hundred feet in depth, caused by the settling of the outer edge of a rock-bluff. at the base of which a river had gnawed away the supporting strata. Innumerable gulches, cañons, ravines, nd valleys, and the partly subterranean courses of springs, are to be scribed in whole or in part to surface agencies. But these are seldom lled with mineral; and there is no great danger of their being confounded ith fissures of subterranean origin.

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* Sir Charles Lyell.

The strongest analogies lead us to believe that the fissures of most re-veins were formed by plutonic agencies; and, indeed, that many of hem are literally the products of earthquakes. Fortunately for science, hough unfortunately for the comfort and safety of men, the occurrence f earthquakes in many mining districts is furnishing us with many llustrations of this theory; and I venture to predict that California, Nevada, and Oregon, when more thoroughly studied, will afford abundant ew materials for a completer understanding of the subject.

It should be remarked that the formation of fissures in this manner y no means necessitates their extension to the surface. Probably the reater number of fissures do not at first break through to the air, but re afterward exposed by denudation of the over-lying crust. The occurrence of "blind veins" is familiar to miners. Other fissures, again, ay have been covered with alluvial deposits, so as to be, perhaps, forever hidden from the eyes of men. There is, I think, reason to believe hat the volcanic regions of Mexico extended into Louisiana, where they re now covered with tertiary formations.

The depth of fissures I have already mentioned. There is no well-authenticated case on record in which the absolute bottom of a vein has een found by mining. That they reach through the solid crust is trongly indicated by the frequent instances of latitudinal movement in he country-rock. But, as Cotta acutely remarks, the thickness of the olid crust is, locally and temporarily, much reduced in the neighborhood of volcanic eruptions. Moreover, the movements of the country-rock may be caused, to some extent, by the formation of new fissures. ertainly we can scarcely assume that fissures are, in general, deeper han they are long; but the horizontal length of a fissure, or chain of issures, may far exceed that of its apparant outcrop. It is not likely hat mining will ever be carried on to a greater depth below the surface han four thousand feet.* Economical, if not mechanical, difficulties ill decisively interfere. As single fissures have been traced for twenty iles upon the surface, and systems, of probably connected fissures, uch as the mother lode of California,) for much greater distances, we ave no reason to believe that human explorations will reach their limit n depth.

Branches or spurs, and "horses" or masses of the country-rock in fissures, re characteristic features, and serve in many doubtful cases to istinguish between veins and beds. As a bed is always a member of he formation, younger than the underlying, and older than the over-lying members, it could not, of course, be attended with arms or ranches penetrating the later rocks, since these did not exist while t was forming.

"Heaves," "slides," "throws," "faults," &c., which are movements of he inclosing rocks, generally along the lines of later fissures, are frequently observed in connection with veins; but it is a mistake to suppose that a sheet-deposit, thus dislocated, is necessarily, therefore, a ein. It is the observation, not the occurrence, which is, perhaps, more ommon with veins than with beds.† A little reflection will show that such a movement, if it cuts a vein in two, and "heaves" one part sidewise, more or less, from the other, must produce the same effect on the rock-beds of either wall. The cross-course, or line of the dislocation, must be a fissure, but the body dislocated may be a deposit of any class.

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*Apparent exceptions by tunnels in mountain ranges might occur, but they do not ffect the general force of this proposition.

†Even this I doubt. Coal-seams alone present faults and dislocations as abundantly s any veins.

It is a practical problem of much importance, to find in the cheapest and most expeditious manner the continuation of a vein which has been cut off by a slide or heave. The observations and calculations involved are frequently delicate and difficult; nevertheless, the alternative usually adopted in this country, of going blindly into the barren rock, and trusting to luck, is without excuse. I could give several instances within my own knowledge, in which promising enterprises have been ruined by occurrences of this kind, for the want of careful surveys and intelligent reasoning on the part of engineers. The lack of such surveys in the mines of Lander Hill, Reese River, for instance, has produced great loss, and even at the present day, the great and costly experience obtained in many different mines of that locality is almost worthless for future guidance, and is fast being forgotten. The terms "fault" and "dislocation" are general in their application, signifying the removal of one portion of an intersected bed or vein from the other, so that the continuance of the deposit beyond the dislocating line is no longer in the extension of the same plane. Heaves are faults in which the hanging wall of the cross-fissure seems to have been lifted; slides, on the contrary, present the appearance of a downward movement of the hanging wall of the cross-fissure. As, in both cases, the fault is produced by a movement of comparatively large masses of rock, it is evident that the extent of dislocation, depending on the amount of motion and the angle of the two fissures, must be the same for all parallel veins faulted by the same cross-fissure. Even when the faulted veins are not parallel, if the fault is the same, its extent can be mathematically calculated from one known case to another not yet explored. In entirely new districts, it is more difficult to infer the extent and direction of dislocations, though careful observation will generally give some clue. The complication of the matter by oblique movements, compound fractures, successive dislocations, &c., is so great, that it cannot be discussed without diagrams and models, nor thoroughly taught without field practice. I venture to lay down one or two rules, which are not without exceptions, but will serve to assist the practical miner in the necessary local investigations.

1. Whatever be the irregularity of the faulted lode, the faulting fissure is generally found to be a pretty regular plane, especially if the dislocation exceeds a few feet. When the faulting fissure has itself gone through the processes of vein-formation, and become a mineral vein of considerable width, this is less likely to be the case; but ordinary clay-seams, cleanly cutting off veins, and dislocating the two parts, are likely to be quite regular. Hence, when their strike and dip have been carefully determined, the places where they will cut other neighboring veins, or the same veins in different depths, may be approximately calculated.

2. In such cases, a slide is rather to be expected than a heave; that is, the hanging wall of the cross-fissure is more likely to occupy a position lower than its original position, than the reverse. The proofs are two, theoretical and practical. Theoretically, the most probable causes of movement of either wall would be the weight of the hanging wall, and the upward force which may have caused the fissure. The first would move the hanging wall down, and the second would push the foot-wall up, producing the same relative effect.*

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* In rare instances, the cross-fissure is vertical, and this distinction cannot be observed

3. The continuation of a faulted vein is therefore most naturally (in
absence of more decisive indications) to be sought on that side on
ich the vein makes an obtuse angle with the cross-fissure.*

4. In searching for the continuation of a faulted vein, when the move-
nt was greater than a few feet, it is better to run a cross-cut, or sink
inze, than to follow the cross-fissure, since the latter is frequently
ed with clay or breccia, and almost always so altered and decomposed
water, &c., that the vein may be passed by and not recognized. A
ss-cut will pierce the continuation of the vein if the fault is a slide;
d a winze is more likely to be successful in case of a heave.

hese suggestions do not cover all cases, but only those most fre-
ntly occurring in our faulted gold and silver deposits. For further
ormation, the professional books must be consulted.†

Double veins, or those in which, subsequent to the first filling, a new
uption, mainly in the plane of the first fissure, has taken place, and
ew vein-material, *imperium in imperio*, has been deposited, require
further explanation. Where they occur, it is often noticed that one
n is richer than the other; and the rich zone sometimes jumps from
wall of the double vein to the other—a result of the irregularity of
second fissure. Let any one try to break apart along the original
of fracture two pieces of wood, well glued together, and he will find
t the new fissure will not follow the old one.

lickensides, or polished surfaces in the vein-matter, or along the
ls, are produced by small movements of rock-masses, rubbing on one
ther, with water and sand or clay between. Exactly the same pro-
s may be seen at any marble-yard.

triations may often be seen on the walls, where a movement has
en place. They are produced by sharp points or crystals, resisting
general polishing. Often a study of them will show the direction of
movement—an important fact for the miner. The theory that the
est ore-deposits lie in the veins always parallel with these striations
upported by a few local observations, which I regard as mere coinci-
ces.

he filling of fissures is at once the most difficult and important and
least understood department of the science of ore-deposits.

do not desire, in this place, to propound any theory of my own.
re is scarcely room for a new hypothesis; and the truth is probably
be approximated by judicious eclecticism, allowing to many of those
ady set up, a share in the results. The most important agencies are
ognized in the very earliest theory, that of Agricola, who, in 1546
l 1571,‡ ascribed the formation of veins to water, heat, and cold. It
rue, he assumed the transformation of other elements into metals;
many compounds were in his day considered as elements. Another
ient author, Balthasar Rösler,§ declared veins to be filled fissures;
l Becher|| distinctly asserts the activity of vapors from the earth's
erior as a cause of their occurrence. These and other following
hors were more nearly correct than the great Werner, who gave his
werful authority to the theory that the vein-material is in all cases a
cipitation from above into the fissures, from a solution (or mechani-
suspension in water) covering the surface of the region, at the time

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This rule applies to slides only. Heaves follow the exact opposite.

See Cotta's Ore-deposits, and especially Lottner's *Bergbaukunde*, Berlin, 1869, Bd. I,
9-44.

De Ortu et Causis Subterraneorum; and De Re Metallica.

Der Hellpolirte Bergbauspiegel. 1700.

Physica Subterranea. 1703.

when the fissures were open. Facts were too much for Werner's theory, and an extreme reaction showed itself in the injection hypothesis, according to which veins were formed by the injection into the fissures of melted matter from below.

This had the phenomena of volcanoes as analogical support: but volcanic eruptions appear in all ages to have produced only volcanic rocks; and the type of these is well marked; so that the analogy really overthrows the theory, which must be rejected for all except eruptive veins, frequently called dikes.

Elie de Beaumont declares veins to be the products of volcanic emanations; but includes under this name thermal-aqueous solutions and metalliferous and sulphurous gases, as well as melted injections. In this extended sense, his explanation will doubtless apply to the majority of cases. The opinion that in most veins the material did not enter from the surface, nor from the country-rock immediately adjacent to the place of its present deposition, is now entertained by all.

It is especially in this country that light will be thrown on the subject. Our vast gold and silver belt (particularly the latter) abounds in illustrations of all stages of volcanic action, direct and indirect. It is the scene of earthquakes, geysers, and metallic depositions still, and the barren surfaces of its mountain ranges give unequaled opportunity for the study of results already wrought out by these processes. I think the contribution to geology from the Pacific slope and the inland basin will effect three things: It will restore to volcanic agencies a portion of the importance which chemical geologists have lately been prone to deny them; it will afford fresh illustrations of the metamorphic action of chemical solutions, vapors, and gases; and it will show the filling of veins by thermal-aqueous and solfataric action. In other words, it will vindicate the geological importance of fire, gas, steam, and hot water, all produced from subterranean sources.

A few veins contain ores deposited by sublimation, (especially specular iron, frequently found in volcanic fissures;) and another class may have been filled by secretions from the adjacent country-rock; but of the vast majority of ore-veins, we may assert that they were filled from below, (if from the country-rock, then at greater depths than we can attain,) and by means of solutions, vapors, and gases. The distribution of ore in this way is affected, no doubt, by many causes which we cannot now trace. It seems to me that the essential elements of the problem are the condition of the fissure at the time the ore entered it, and the nature of the deposition of ore, whether mechanical, as by the cooling of a sublimation or the evaporation of a solution, or chemical, as a result of reactions producing insoluble precipitates. The condition of the fissure is important, as one or two suggestions will show. Its width, for instance, would determine currents and their rapidity, and thus affect the mechanical deposition, even of chemical precipitates. Horses, and lines of contact between the walls, or even mere contractions without contact, would cause the fissure to be choked at some points and in some lines, earlier than at others; and subsequent depositions of ore would take place in chimneys, or ore-bodies, in those spaces to which the currents found readiest access. With regard to the second element mentioned—the nature of the deposition, it may be said to be essentially mechanical, whether the precipitates are already formed and held in suspension, or are formed by cooling or by chemical reactions subsequent to their entrance. The deposition of the former, however, is perhaps more dependent on the fissure; that of the latter, on the nature of the country-rock. Probably little, except clays, &c., is brought

to veins in mechanical suspension. The majority of cases indicate
ystallization by cooling and chemical change. A simple laboratory
periment will show what are the most obvious effects of the wall-rock
on this process. Let a hot solution be placed in a vessel constructed
rtly of glass, partly of metal, partly of polished wood, and partly of
ugh wood. As the liquid cools it will be seen that the crystal incrus-
tions are deposited unequally, according to the varying capacity of
ese different substances to conduct heat, and according to their sur-
ce. The best conductors and the most rugged surfaces receive the
rliest and most abundant deposit. The difference in surface is prob-
bly only an element of the conduction of heat; so that we may say in
eneral that the best conductors of heat receive the largest crystalline
eposits. The specific gravity of substances is directly connected with
eir conduction of heat. Hence, rough walls, of a rock of high spe-
fic gravity, would naturally be the localities of crystallization in veins.
his is only saying that solutions or vapors crystallize first where they
ol quickest. The frost on a window-pane is an illustration. Whether
is crystalline deposit will be ore or gangue, depends upon the nature
the solution or vapor first entering the fissure. There is also, in many
ses, a chemical reaction between the solution in the fissure and the
ll-rock. Certain ingredients of the rock change places with others in
e solution. Thus, for instance, chalybeate and other mineral waters
ntain bi-carbonates of iron, lime, &c. These, by the absorption of
re iron or lime, would become common carbonates, and insoluble.
e wall-rock of the fissure may supply the additional base, and the re-
lt will be a crystallization of iron or lime spar in the vein, while the
ll-rock becomes porous, or, receiving new ingredients, (silica, &c.,) in
ace of those it has surrendered, presents a zone in the neighborhood
the vein of very different character from that of the general country-
ck. These reactions have been studied a good deal of late; but there
much to be still explained concerning them. I will only add here
at not only the chemical constitution, but also the texture of the wall-
ck, promotes or prevents such processes. A porous rock, or one that
ke some porphyries) presents considerable surfaces of combinations
sily decomposed, (alkaline silicates, &c.,) will be acted upon easily,
hile a solid, homogeneous rock would resist decomposition.

The crossing of two veins may assist the deposition of vein matter
th mechanically and chemically. The supposed electrical currents in
e rocks have also been appealed to; but their activity is not proved
yond the realm of galvanic or electro-chemical effects; in other words,
chemical reactions.

Finally, the distribution of ore in a vein is to be considered as a series
relative concentrations. The absolute or total richness of the vein
ust depend upon the amount of metallic substances introduced into
e fissure. This we can only infer from the size and general metallif-
ous appearance of the vein. The practical distinctions of miners, as to
strong" and "well-charged" veins are, therefore, quite in accordance
ith theory.

Among the indications which throw light upon this important ques-
on, in advance of thorough explorations, are the traces of extensive
emical changes in the vein and adjacent rock, and especially the traces
superficial decomposition by meteoric agencies. The valuable metal,
ch as silver or copper, may have been almost entirely removed by these
anges; but the indications of its presence may remain. This is the
gnificance of the "iron hat" or gossan which forms the outcrop of many
luable copper, silver, and gold veins. The changes above water-level,

in most veins, consist in oxidation or chlorination, solution and removal of some ingredients, and sometimes reduction and precipitation. Thus the gossan outcrops are produced by the oxidation of sulphurets, &c., and the removal of soluble sulphates. Sometimes these soluble salts are again precipitated below, as in Tennessee and Virginia, where percolating surface waters have oxidized pyritic deposits to gossan, and carried the copper sulphates down in solution to the lower drainage-level, where they have been precipitated by iron or organic substances as a zone of "black copper." In many cases the water-line, or line of deepest drainage for surface waters, is characterized by a barren zone in the vein. This is called, in some localities, the cap-rock; but, like the alleged regular systems of chimneys of ore in veins, its universal occurrence is by no means proved. Miners in Colorado, for instance, call all barren sections of a vein cap-rock, while every body of good ore is a chimney; and this is about all that science could safely say in the case. The occurrence of relatively barren spaces in veins is inevitable and universal. It is discouraging to the expectation of future success or not, according to the size and metalliferous character of the vein. On the Comstock vein, for instance, the extent and number of the ore-bodies already explored, forbids the supposition that the vein is barren in depth, while the extent and number of the barren spaces, already explored, justifies the apprehension that the alternations of rich and poor ground in depth will be on an equally large scale.

Characteristic for veins are the selvages or layers of clay (fluccan) along the walls. These are sometimes wanting in true veins; but never, so far as I know, are they found distinctly developed in beds.* They result from the percolation of water along the walls, the pressure and slight movement of the latter, and the chemical changes caused along the plane of contact between vein material and country-rock. In some districts they are called "gouges," because they enable the miner to work with a pick between the vein and the wall, and so to expose a side surface, which greatly facilitates blasting out the vein. The mother lode of California is noted for the wide gouge along the foot-wall. The vein is thus easily stripped, and large quantities of quartz are thrown by a single blast. I saw a piece weighing about 25 tons, in the Amador mine, thrown down in this way; and much larger quantities have been lifted and loosened by single blasts in that mine.

In concluding this prolonged, yet merely outlined discussion of veins, I would once more urge the suggestion which constitutes its most important feature, and for the sake of which I have written the whole. It is the vital necessity of less general theory and more particular study. Engineers in practice might well throw away half their notions about *all* veins, and substitute a clear and definite comprehension of some veins. Our country will certainly afford new and striking facts in this department of science; but they must be observed carefully, and not seized upon, to be pressed into the support of crude generalizations or preconceived theories. Our mineral deposits represent all classes and all modes of formation, and will not be ranked under any man's pet hypothesis. Meanwhile, for their successful exploitation, it is sufficient and essential to rely upon the acknowledged principles of safe and wise engineering, and upon faithful and intelligent local observations.

Beds and seams.—Veins, as we have seen, are characterized to the eye the miner by the following signs: sheet-form; linear extension in gth and depth; generally steep dip; irregularity of ore-distribution; ations with other parallel or intersecting veins; and indications of a vious fissure, filled with matter of later origin than the country-rock. Beds, on the other hand, while they have the sheet-form, approach horizontal plane in their original position, (though they are tilted erever the inclosing rocks are also tilted,) have no particular connec- n with other parallel beds, (since these must be older or younger, ording to their position above or below, but never of the same age,) tain their ores or valuable minerals more evenly distributed. They frequently faulted by cross-fissures, but cannot themselves be the use of faults in other deposits. The principal ores occurring in beds those of iron, copper, lead, zinc, and sulphur. Many gold deposits the southern States are probably beds—that is, layers of the country- k, distinguishable from the overlying and underlying strata by their ater proportion of quartz and gold. Beds of valuable minerals are quently found in the form of basins, or in lenticular form, thinning t on all sides. They have also their variations in thickness and dip; t these are much less common and less violent than those of veins. ds are also subject, like veins, to internal metamorphosis, by means chemical reactions, percolating waters, &c.

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* Beds highly tilted, so as to have maintained for an indefinite period a position like that of most veins, are sometimes observed to have a sort of selvages; but there is no natural separation, in most cases along the walls, any more than in the strata-cleavages of the deposit itself. Hence, such beds may show fluccan anywhere in their mass.

Mass-deposits are still more various in their methods of formation than ins. Both the preparation and the filling of the mold, so to speak, y have taken place in many different ways. Some masses are depos- , chemically and geologically analogous to those of veins, except that ey have taken place in caves or irregular spaces in the rocks, not sures in the usual sense. Thus the lead ores of Illinois, many iron es in dolomite and limestone, &c.. Other mass-deposits are, strictly eaking, networks of small veins; as, for instance, the chrome-iron ores Pennsylvania. Others are produced by the penetration of metalliferous solutions into porous or decomposable rocks, and the gradual pregnation of the latter. Finally, a mass-deposit may be the result more than one of these processes. It is even more emphatically true these deposits than of veins that each example needs to be studied itself. There are no general rules which will serve to guide, either the discovery or in the exploration and working of such deposits.

Impregnations are to be considered as in some sense a variety of mass- posits. Their characteristic feature is the absence of defined limits. hey are limited for the miner by the gradual decrease in richness, aching finally a point where it will not pay to work them. They fre- ently accompany other deposits as a sort of indefinite boundary; but ey also occur independently. The silver deposits of White Pine are be classed (so far as I can at present decide) as masses and impregna- ons in certain strata of the limestone. The Eberhardt mine illustrates e fact that deposits of this kind may be faulted as well as veins. The ass-deposit of the Eberhardt is sharply cut off on the north, and less arply on the south, by what seem to be cross-fissures.[*] The uncer- inty under which the miner labors as to the extent and form of mass- posits is, as Cotta well remarks, fortunately counterbalanced by the ually large dimensions of this class of deposits, and, as I would add, the comparative small depth, and the consequent ease and cheapness extraction and of exploration. All these points are illustrated in hite Pine.

Passing over without further remark the subject of pockets and small

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See chapter on White Pine.

segregations, I will close this chapter with a general list of the occurrences of the precious metals.

Gold occurs in veins, beds, and pockets; in impregnations of rocks, (slate, granite,* &c.;) in placers, &c.; ordinarily native, but frequently associated with sulphur, arsenic, &c., and accompanying silver, copper, or iron.

Platinum is distributed similarly, but has never been profitably obtained, except from placers.

Silver is found in veins, beds, nests, masses, impregnations, &c., rarely native, and not generally in ores of silver only, but rather as an accidental constituent of lead and copper ores. Large portions of the silver belt of the United States are characterized by unusual purity of silver ore and freedom from base metal. I think it likely, however, that this distinction will vanish in depth. Even at present, the ores sent to mill are in most cases kept free from base metal by throwing away, in sorting, the base-metal compounds. The utilization of the base metals themselves, or at least the economical treatment of their argentiferous ores, is necessary to permanent prosperity in silver-mining.

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* I have seen gold disseminated in true tribasic granite from southern California, and a similar instance is reported to me from Mammoth district, Nevada; but in the latter case I have some reason to doubt the nature of the granite and its actual impregnation.

PART IV.

THE MECHANICAL APPLIANCES OF MINING,

WILLIAM P. BLAKE.

INTRODUCTORY.

CHAPTER LXIII.

IE MANUFACTURE OF MINING MACHINERY IN CALIFORNIA.

The great demand for mining implements of all kinds which attended e sudden development of gold mining in California was at first sup- ied from the Atlantic States and from Europe. Some of the first artz mills erected in the State were imported from England. Relics them may still be found in Grass Valley and on the Mariposa tate. But this dependence upon eastern and foreign workshops did t long continue; founderies and machine-shops were started in San ancisco, and their extent and number has been increased to keep pace th the rapid enlargement of the mining field of the Pacific slope. ith the constantly increasing discoveries of new districts, and the open- g of new sources of gold, silver, and copper, the demand for machinery s been enormous and peremptory. But it has been most succesfully t by the mechanical engineers of the Pacific slope. Their work is aracterized by great boldness, independence of precedent, ingenuity d originality; and they to-day furnish some of the best machinery in e world for certain departments of the art of mining.

The directions in which the greatest advance has been made are: The improvements in breakers, stamp-batteries, &c., and the substi- tion of iron for wood in stamps and ore-dressing and concentrating achines. 2. The manufacture of pans for grinding and amalgamating. The introduction of silvered and amalgamated copper-plates for sav- g gold and quicksilver. 4. The art of placer mining has been revolu- nized; cumbrous and slow working hand machines have given way to gantic operations which in their extent and effect approach those of ature. The under current sluice is but one of the improvements to hich the development of this art has led.

The effects of the discoveries, and of the improvements following them, ve been wide-spread. Invention and production have everywhere en stimulated. Attention has been steadily directed to the invention machines to be substituted for hand labor, especially in rock-drilling, d to the improvement of explosives, all tending to diminish the cost moving rock and extracting the precious ore. Rock-drilling machines ve passed through a great variety of modifications in the United ates, and the Leschot diamond drill, which originated in France, here ds its greatest development and its most general and successful prac- al application.

The iron founderies and machine-shops of San Francisco have been stained chiefly by the demand for mining machinery, and were most merous and successful in 1865 and 1866, during the period of greatest pansion in prospecting and mining, and the formation of companies develop claims and mining ground in all directions. The value of the stings produced at these founderies in the year 1866 is estimated at le less than two millions of dollars, the greater portion being for quartz mills and mining machinery. There were then thirteen establishments in full operation, employing about 1,000 men. The number of large establishments now in operation is somewhat less. In addition to the works in San Francisco, there are founderies in the other large cities, as Sacramento, Stockton and Marysville, Nevada City, and at nearly all the chief mining centers, where mills are built, shoes and dies cast, and repairs made.

The principal establishments in San Francisco at which mining machinery is manufactured are the Union Iron Works, the Pacific Iron Works, the Vulcan Iron Works, the Miners' Foundery, and the Golden State Iron Works.

The first named is the pioneer establishment, having been founded in the year 1849, by the Messrs. Donahue Brothers, upon a very limited scale, from which it has grown to be the largest and best appointed on the coast. At the commencement, the blast for melting was produced by a blacksmith's bellows, and the tools and materials were few and imperfect. At present, there are in the machine-shop twenty-five lathes, eight planers, and much powerful drilling, cutting, gearing, and shaping machinery. One of the planers is the largest in the State. The smithery is provided with a fifteen-ton steam hammer for forging large work, and the boiler department has automatic punching and riveting machines. The main building is of brick, three stories high, with a frontage of 187½ feet, and a depth of 120 feet. About 300 men are employed.

The Pacific Works were started in 1850. In 1867 they worked up 700 tons of pig iron, 350 tons of bar and plate iron, with 700 tons of coal; and the value of the product was $300,000.

The Vulcan, in 1867, worked up 1,200 tons of pig iron and 200 tons of bar and round iron.

This brief mention of some of the more important of the machine making establishments will serve to give a general idea of the capacity of the coast for the production of mining machinery.

California not only manufactures mills and machinery for the Pacific slope, for Nevada, Idaho, Oregon, Washington, and Arizona, but exports to British Columbia, Mexico, Central America, South America, Colorado, North Carolina, and, to some extent, to Australia. Its stamp-mills for gold quartz crushing are superior to any other, and are regarded as models to be followed. There is no country where so much money and effort has been expended in so short a time in experimenting with, and perfecting, the various machines used in mining; and although it may be said that there has been a great waste of material and money in the headlong, blundering way in which the progress has been made, it must be admitted that the result on the whole is more satisfactory than it would probably have been by this time, if every problem had been the subject of slow and careful deliberation. The great value of time and labor in these new and rapidly expanding metalliferous regions is to be considered, and likewise the enormous rates of interest, ranging from twelve to thirty-six per cent. per annum; the great cost of transportation, ranging from five to twenty-five cents per pound; and other conditions very different from those in older mining regions, so that it is not possible to make any just comparison between the one and the other without giving a fair consideration to these peculiar and difficult circumstances under which the development has been made.

In the following notices of the mechanical appliances of mining the attempt has not been made to give a complete description of them all. Neither time nor the space allowed permitted this; but it has been the endeavor as far as possible to describe the machinery and apparatus of

iining now in use on the Pacific slope, and to add such notices of ma-
ines used abroad for similar purposes, and to make such comparisons
s would be likely to interest and instruct those engaged in mining,
nd to furnish the data for a general reply to the natural inquiry, what
the position of the United States in this respect, compared with that
f European countries.

The writer desires to make special acknowledgment to the Union Iron
Vorks of San Francisco for drawings of stamp-mills, hoisting works, and
ther machinery, from which many of the illustrations have been reduced
r these pages. He is also indebted, for valuable information, to Mr.
rving M. Scott, to Mr. Moore, of the Vulcan Foundery, and A. S. Hal-
die, esq., president of the Mechanics' Institute.

For information concerning the machinery now in use abroad, he has
onsulted his own notes upon the machinery at the Paris Exposition, and
lsewhere, and the works of Burat upon the machinery of the Belgian
nd French collieries. Having recently, in part, rewritten the report
pon mining* in the series of reports upon the Paris Exposition, he has
lt at liberty to make free use of those pages and of many of the illus-
rations, electrotyped copies of which had been secured for the purpose.

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* Report on mining and the mechanical preparation of ores, by Henry F. Q. D'Aligny
nd Alfred Huet, F. Geyler, and C. Lepainteur. Washington: Government Printing
ffice. 1870.

SECTION I.—AGENCIES AND INSTRUMENTS OF BREAKING DOWN ROCKS AND ORES.

CHAPTER LXIV.

WATER—HYDRAULIC MINING.

The placer miner avails himself of the results of forces which have been cting for unnumbered ages. Frost, ice, and mountain torrents, aided y the decay of rocks, have broken down the veins and liberated the gold, aving it distributed under the gravel and sand in the beds of ancient and xisting streams. The force required for breaking up the rocks and veins as been expended and the work of the placer miner is rather to clean up, r harvest, what nature has already mined for him. But the operations f nature have been so vast, and so gigantic have been the deposits ade by rivers and floods, that the pick, shovel, and pan are inadequate r the profitable collection of the gold, and other mechanical appliances re brought to bear. Powder and nitro-glycerine are used to blow up d disintegrate the deep and consolidated deposits; water under pressure is made to undermine and wash away high banks of gravel; powerl cranes and hoisting apparatus, and for some of the harder cemented avels massive stamp-mills, are required.

As water was Nature's principal instrument in preparing these earth posits, so, also, is water the surface miner's great agent for breaking wn and reassorting them. It is brought to bear directly upon the aterials, either with the momentum it acquires in falling from a considable elevation, or with the gentler force of a shorter fall as it runs down sloping channel. The first is the *hydraulic process*, and the second is *icing*. The operation of the first is to break and disintegrate, and of e second to separate, assort, and concentrate. In hydraulic mining, e two are necessarily connected and form one continuous operation. ater falling through pipes from a height of from 100 to 200 feet is delived through nozzles in continuous streams against the base of a bank earth. It undermines the bank; the overhanging masses fall to the se and are broken apart and loosened; the water penetrates every ack and pore; large boulders are thrown aside like pebbles; the whole ass is stirred and mingled, while the accumulated waters flow away wn the slope thick with sand and earth, leaving the larger boulders d the gold resting clean-washed upon the surface of the bed-rock.

This process is applicable wherever deposits have accumulated to such depth upon the lower stratum holding the gold that they cannot be onomically removed by digging. For its successful operation there e two essential conditions: first, sufficient head or height and quantity water; second, a rapid fall or slope from the base of the bank, so that e water will flow swiftly away and carry the loosened gravel, sand, and rth with it. In California there is comparatively little difficulty in taining these conditions by an adequate expenditure of money. The h mountains give numerous streams flowing toward and across the d region, and the deep valleys and ravines permit of ample fall and drainage. But the streams have to be diverted from their courses carried in ditches and flumes for many miles along the hillsides, w in most cases the best gold deposits are in trough-like or basin-sha depressions, hemmed in by rocky walls, through which artificial out must be cut, so as to give the requisite drainage.

Thus, when the position, depth, and richness of a deposit are as tained, and it is decided to work it by the hydraulic method, the operation is to provide an outlet for the water. This is done by cut a tunnel through the rim-rock from an adjoining ravine or valley, s to tap the lowest part of the basin, and, if possible, to secure a vert fall of fifty to one hundred feet from the base of the deposit. Such nels are usually costly and laborious undertakings; they require g engineering skill for their proper projection, and often many yea time. In driving some of the longer tunnels, from five to seven y have been consumed and an expenditure of from $10 to $60 per li foot incurred. They vary in length from a few hundred feet to a n and are usually from six to eight feet in width by seven in height.

MINING DITCHES IN CALIFORNIA.

In the year 1867 there were 5,328 miles of artificial water-courses mining purposes in the State of California, besides the subsidi branches, estimated at over 800 miles more. These water-courses ditches cut, wherever possible, into the earth of the hillsides, a crossing rocky points and deep valleys by means of flumes, or, bette iron pipes. The ditches are usually about eight feet wide at the top, at the bottom, and three feet deep. The grade varies from twelve eighteen feet to the mile. Formerly flumes were constructed on a la scale and at great cost; but now large sheet-iron pipes are substitu with great advantage in durability and economy. Some of the flu were of great length and height; one near Big Oak Flat, in Tuolu County, being 1,300 feet long and a part of it 256 feet above the surf and supported upon wooden towers. Upon the Truckee ditch th were, at one time, 13 miles of flume, eight feet wide and four feet de hung upon the side of a deep cañon. Upon the Pilot Creek ditch th was one piece of flume 300 feet long and 95 feet high.

The boards used for making flumes are usually from one and a quarte one and a half inch thick. They are laid down rough and then batte Sills are placed at intervals of two and a half feet, with posts and a cap the support of the flume-box. The sills are four inches square, the po three by four, and the caps one and a half by four inches. In additi to the first cost of a flume, it is expensive to keep in repair, and is lia to a great many accidents. It may be burned or blown down, and if is left dry for several months, all the boards curl up and split so th they cannot be used again. It is said that the repairs of a flume co 90 per cent. more than those of a ditch. For all these reasons, flu are not now constructed where they can possibly be avoided, and ir pipes are substituted. These pipes are made of stout sheet-iron boiler-iron, and vary in size from 10 to 40 inches in diameter, accordi to the quantity of water to be carried. From 7 to 11 inches is a com diameter for the smaller pipes, and these are made of No. 20 iron. sheet two feet wide and six feet long will make two joints of 11-in pipe. These joints are put together to form sections 20 feet long, a these sections are united upon the ground and secured by mea of strong wire wound around two projecting ears or hooks of iron, o upon each section. The whole pipe is also firmly fastened to the surfa posts securely set in the ground, to prevent its weight from carrying own the steep slopes. The examples of the successful use of pipes carrying water across depressions and ravines are numerous. Upon South Fork Canal, in Eldorado County, a pipe is used to carry 50 ies of water across a valley 1,600 feet wide and 190 feet deep. This is 10 inches in diameter, the iron about one-sixteenth of an inch thick, the supply end is ninety feet higher than the delivery. On the elsior Company's ditch, near Smartsville, there are five miles of low ie, 6,000 feet of 40-inch pipe, 3,000 feet of 20-inch pipe, and half a of 38-inch pipe. The 40-inch pipe crosses a depression 150 feet p, and with a head of thirty-two feet carries 2,500 inches of water. n the Dutch Flat ditch there are 3,500 feet of 31-inch iron pipe and feet of 32-inch pipe.

he aggregate cost of the ditches in California for the supply of water eported as $15,575,400.* They are generally built by companies and ied distinct from the mining companies; and the water is sold to the ers at so much per inch per day of ten hours.

THE MINER'S INCH OF WATER.

he miner's inch of water is not a very definite and fixed quantity, for methods of delivering it differ in different places. It varies acding to the pressure or head and the height of the aperture. Usually pressure is six inches, and the aperture is a horizontal slit one inch h and about twenty-four inches long, which can be closed to any ded degree so as to leave an opening one inch long, giving one inch of ter, or ten or twelve inches long, giving corresponding numbers of es of water. It is thus usual to consider the miner's inch as that ntity which will pass through an opening of one square inch area der a mean pressure or head of six inches. The quantity discharged n such an opening (one miner's inch) in twenty-four hours is equal to 74 cubic feet. A cubic foot is equal to 7.49 United States gallons, or rty-eight miner's inches.

he Eureka Lake and Canal Company deliver water through an aperre two inches high and under a pressure of six inches. The amount livered by them through an aperture twenty inches long and two hes high is considered to be forty inches. Upon the Excelsior ditch, d also upon the Sear's ditch, water is delivered under a pressure of inches, measured from the center of the orifice. Upon the Mokene Hill and Campo Seco ditch, water is delivered under a pressure of r inches. The Phœnix ditch Company deliver it through an orifice e inches high and under a pressure of four inches over the orifice. n the Gold Hill ditch, El Dorado County, a miner's inch has been sured out through an orifice two inches high and an inch wide under ur-inch pressure. Another ditch in El Dorado County has sold for inch of water the amount that escapes through an orifice three hes high and an inch wide without pressure.

t Smartsville water is sold with a head of nine inches with a four- opening 125 inches long, giving 11.8 per cent. for an "inch" more is usually given. The quantity discharged through an opening four es deep, with a nine-inch head over the middle of the opening with coefficient of discharge =.0615 is 106.6 cubic feet per hour, or 1.7767 c feet per minute.

"head of water" is 500 inches daily for ten hours, and is the quanrequired for a first-class hydraulic operation.

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* Langley's Directory, 1867.

The distribution of the water to the hose-pipes is generally by a
iron pipe leading from the main pipe or reservoir, and connecting at
bottom with a strong cast-iron box. This box is provided with o
ings in different directions, to which the smaller pipes are fitted;
these again connect with flexible canvas hose, strongly made and
ered with netting and bound at intervals with iron. They terminat
brass nozzles with orifices from two to three inches in diameter.

ECONOMY OF THE HYDRAULIC PROCESS.

It is not easy to estimate the average cost of washing by the hyd
lic process. It requires not only very careful measurements of the l
of the materials removed, and of the amount and pressure of the w
used, but the nature of the material must be taken into the acco
whether hard or soft, cemented or loose gravel, sand or stiff clay; for
rate of progress will vary greatly according to the resistance of the
terials to the disintegrating or moving action of the water. The fo
ing, from a report made by the writer in 1859, may here be cite
showing the estimate at that time of the value of the hydraulic met
compared with hand labor:

> As a labor-saving process the results of this method compare favorably with t
> attained by machinery in the various departments of human industry where ma
> labor has been superseded. With one pipe of an inch and a half or two inches
> ture and a pressure or head of ninety feet, a boy can excavate and wash as much a
> erous earth in one day as could ten or fifteen men without its aid. It is common t
> timate the work of a pipe as equal to the labor of ten men; in some locations a pi
> the size mentioned might effect more than twenty men in the same time. The w
> is ever active and untiring, and works as rapidly in inaccessible places as upon a
> posed bank. The quantity of earth moved will, of course, vary greatly at diffe
> places, depending chiefly upon its character; whether sandy, a mixture of clay
> sand, or clay alone. The amount of gravel and boulders also varies greatly in all
> placers. From measurements made last year in North Carolina, where a pipe of
> dium size had been in use at the Wilkerson placer, I estimated that with a hea
> sixty feet, and a pipe of one and a half or two inches in diameter, over a thou
> bushels of earth could be moved and washed in a day. If this estimate is con
> earth which contains only the twenty-fifth part of a grain of gold, or about two m
> worth in a bushel, will pay about two dollars a day to a pipe. In washing by this
> cess it is essential that the fall or descent of the bed-rock from the point being wa
> should be sufficiently rapid to insure a swift current in the waste water, so that it
> carry the loosened sand and clay away in suspension or force it along the sluice box

In California, at Gold Run, upon the railroad divide between B
River and the North Fork of the American, the gravel is very soft a
deep; there is abundance of water under great pressure, and all t
conditions are extremely favorable for the hydraulic process. It is n
necessary to spend time in blasting the hard cemented gravel, as
Smartsville, or to puddle, as at La Porte or at Dutch Flat, to remo
large boulders; the washing continues without interruption. Two m
can do all the work in a claim that uses 300 inches of water. It is e
timated there that one pipe will break down as much gravel as th
water from three pipes can wash away; while at Dutch Flat three pip
are required to break down as much gravel as the water of one pipe ca
wash away. Estimating, as is there done, an inch of water to be eq
alent to a supply of 145 pounds per minute, or 8,700 pounds per ho
it follows that 300 inches supplies 15,000 tons in a day of twelve hou
Estimating the quantity carried away by this water as equal to one-te
of its weight (although one-fifth is generally allowed) it follows that 1,
tons are moved, or 750 tons per day to each of the two men. It is no

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* The gold placers of the vicinity of Dahlonega, Georgia.

pposed that this result is uniformly attained, but that it has been at-ined under favorable circumstances.

Mr. Laur, during his visit to California, in the service of the French vernment, estimated that with miners' wages at the uniform rate of renty francs per day, the expense of the manual labor necessary for orking one cubic metre of gravel by the several methods usually em-loyed was :*

	Francs.	Centimes.
y the pan (about)	75	00
y the rocker (about)	20	00
y the long tom (about)	5	00
y the sluice (about)	1	71
y the hydraulic washing (about)	0	28

eing twenty-eight centimes, or about six cents per cubic yard for min-g gravel by the hydraulic method. And this appears to include the st of the water, for he states that during ten days 28,080 cubic metres f gravel were worked over with an expense for :*

	Francs.
ater	5,000
anual labor	864
ndries (about)	500
Total	6,764

From examinations made by Professor Silliman of the quantity of ater used and of gravel washed upon the Blue Gravel Company's aim near Smartsville, it appears that 17,074,758.15 cubic yards of ater were used to wash 989,165 cubic yards of gravel; hence, one bic yard required 17.2618 cubic yards of water, equal to 3,486 gallons.† e whole amount paid out for water during 43 months was $57,261, at e rate of fifteen cents per miner's inch. The cost of water per cubic rd of gravel moved is five cents and seven-tenths, deduced from the egoing; and it is stated by Black that in the Middle Yuba district, th the cost of water twenty cents an inch, the cost of mining a cubic rd of gravel is seven and a half cents.

TAIL SLUICING.

As an example of tail-sluicing upon a large scale, the Teaff sluice, tch Flat, probably the largest in California, may be cited. The total gth of this sluice is 5,500 feet; of this, 2,500 feet are 5½ feet wide d 26 inches deep, in a tunnel; and 3,000 feet of its length is six feet de. It cost $55,000, and was four years building. Several companies iver their tailings into it, with an aggregate of 1,550 inches of water. e bottom is paved with boulders, 14 inches deep, and the grade is ten hes in twelve feet; but it is believed that eight inches would have n better. The descent is broken at intervals of 120 feet by drops, dumps, two and a half feet high in the tunnel and five feet outside. se serve to break up the masses of cemented pebbles, and thus lib-te the gold. The force of the current in this sluice is such that lders of rock ten and fifteen inches, and even twenty inches in meter, are swept along at the rate of nearly ten miles an hour. This constant pounding and attrition of the paved bottom of the sluice by the rolling rocks and gravel wear it rapidly away, this wear being as great as two inches of depth in three months; and half of the paving stones become broken, so as to be unfit for use.

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* De la Production des Métaux Précieux en Californie, &c.

† Report upon the Blue Gravel Gold Mining and Water Company. Inedited.

From fifteen to twenty pounds of quicksilver are put into the sluice daily, in the evening; but as the sluice continually catches quicksilver, swept from the claims above, the owner is never obliged to buy any. He takes out more than he puts in.

Rock suitable for paving is selected from the round boulders swept down the sluice. They are stopped by means of a strong iron grating placed across the sluice in an inclined position. The spaces between the bars measure eight inches, so that only the larger boulders are arrested. A Chinaman, standing by the grate, examines every boulder that stops, and saves those suitable for the pavement.

Among other notable sluicing operations, the following may be mentioned: Hoskins's tail-sluice, at Indiana Hill ravine, in sections, the longest twenty-four feet in length, with intermediate abrupt pitches over rocks. There are fifteen boxes, six or eight feet wide and two or two and a half feet deep, with a grade of eight inches in twelve feet. Moody's tail-sluice, in Cañon Creek, double, two thousand feet long, each eight feet wide and about four feet deep. Kinder and White's tail-sluice, in the same cañon, has two sluices, eight feet wide and seven hundred feet long, grade three inches in twelve feet.

CHAPTER LXV.

HAND TOOLS.

It may at first, to many, seem trivial to devote much space to the form and peculiarities of tools used daily by miners; but this view will not be held when we reflect upon the importance, in the aggregate, of the proper construction of even the simplest and most common implement. With light, strong, and well-proportioned tools, the skillful miner can accomplish much more work in the same time than he possibly could with clumsily and roughly made ones. The American shovel and the American axe may be taken as familiar examples. No one who has sufficient manual dexterity to use them properly can fail to appreciate how far superior they are to other forms for the same purposes.

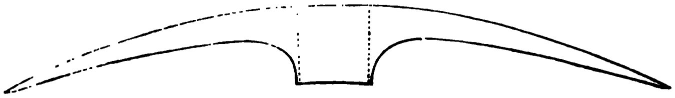
MINING PICKS.

There are three principal types of picks in use among the miners of the Pacific slope, the "surface pick" or ordinary excavating pick; the "drifting" or "quartz pick," and the "poll pick," and a pick for coal-mining. Of each of these forms there are several sizes and different weights, there being not less than 31 in all manufactured by John Wright, of San Francisco, who has made many improvements in the form and quality. I have received from him the following table showing the weight of each size from No. 1 to No. 31:

Picks manufactured in California.

Description.	Pounds.	Number.	Description.	Pounds.
ound-eye surface	4	17	Drifting	4½
....do	4½	18	....do	5
....do	5	19	....do	5½
....do	5½	20	....do	6
....do	6	21	Poll	4
....do	6½	22	....do	4½
....do	7	23	....do	5
lat-eye surface	4	24	....do	5½
....do	4½	25	....do	6
....do	5	26	....do	6½
....do	5½	27	....do	7
....do	6	28	Coal	2
....do	6½	29	....do	2½
....do	7	30	....do	3
rifting	3½	31	....do	3½
....do	4			

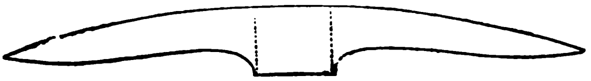
urface pick.—Of the surface pick there are two different styles, the d eye and the flat eye. The first is the common round-eyed exca- ng pick, Nos. 1 to 7, weighing from 4 to 7 pounds, each succeeding ber being half a pound heavier than the preceding. The 5-pound , No. 3, is about the medium and usual size, and is 27 inches long; No. k is 27½ inches long; No. 5 pick is 28 inches, and so on. The next bers, from No. 8 to No. 14, are made with flat eyes, 3 inches by 1 inch, e the round eye are 2 inches by 3 inches for the medium size, varying a with the size and weight of the pick. The lengths are about the same th styles of eye. The round-eyed pick is generally used in surface or er mining, and is probably the most convenient and serviceable pick for work. The eye being large, it is easy to fit a handle, and it is less le to break. The eye, as made by Mr. Wright, being lengthened or d upon the handle from 2½ to 3 inches, gives a firm bearing to the lle, and is a great improvement upon the old style, which merely a lip on each side of the eye. The flat-eyed picks have the same ntage; and they avoid all necessity for strapping the handle. This is preferred for sluicing, as they do not spatter the water so much hose with the round and thicker eye. The heavier picks of these es are used chiefly in grading and heavy digging in bed-rock.



Surface Pick.

he form of the surface pick is indicated by the figure, giving a side of the medium-sized pick, drawn to a scale of one-eighth.

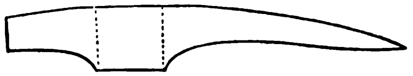
rifting or quartz pick.—The five numbers, from No. 15 to No. 20, com- the different weights of the "drifting" or "quartz pick" made sharp ch end. The medium size (No. 17) is 24 inches long with an eye 3 es by 1 inch. The form is shown by the wood-cut.



Drifting or Quartz Pick.

e weight of this form of pick ranges from 3½ to 6 pounds. The smallest size (No. 15) is used chiefly in contracted, narrow drifts, where there is not much room to swing the tools, and also in working out the gouge or selvage from quartz veins. The sizes 16, 17, and 18 are mostly used in drifts where there is plenty of room, and in pulling down rock. These picks also have the raised eye, and are a great improvement upon the old style. The latter are raised at each side, and have a bearing of only 1¼ to 1½ inch; while in this construction the eye is lengthened from 2½ to 3 inches, and thus gives a firm support to the handle. This is very important for the drifting picks, since they are much used in prying, and in the ordinary construction the handle is apt to become loose.

The poll pick.—The "poll pick" is a favorite form with miners, since it combines the long, sharp point for drifting and a hammer-head for striking and breaking the rock or driving gads. It is a pick and hammer combined. The form, with the raised or socket eye, as manufactured by Mr. Wright, is shown in the figure.



Poll Pick.

The medium size, (No. 23,) weighing 5 pounds, and about 16½ inches long, is most in use; but the weight varies from 4 to 7 pounds, some miners preferring the largest size. It is a form common in most quartz mines, and especially liked by Cornishmen. Such picks are made stout and strong. The hammer end or head in the medium size is 3½ inches long and the point about 10 inches, the eye being 3 by 1 inches.

These various styles of picks are made of the best quality of iron and steel, and for excellence and beauty of finish are unsurpassed. The handles are made of white hickory, are usually 36 inches long for the surface picks, and 34 inches for the drifting and poll-picks.

The poll-pick is evidently made upon the Cornish pattern. In Cornwall the head is usually about 15 inches long, and the handle from 24 to 26 inches. It varies in weight according to the ground to be worked; but 3 or 4 pounds are the most common weights—occasionally 5 pounds. For working downwards a 10-pound head is often used. The poll-pick is the most approved form for working in vein-mines throughout Cornwall, Derbyshire, and the north of England. The double-pointed pick is more used in collieries. Those used for under-cutting coal, called the "holing pick," have handles from 27 to 30 inches long, and in South Wales 34 inches. Picks with handles of unusual length are used in England at the Box Tunnel stone quarries, where the stone is soft and can be cut like coal, and has to be cut out in great blocks. The handles are from five to six feet long. When the men have struck the blow they drop the pick and then draw it out. In the extreme west of Cornwall, where the lodes are very narrow, only 3 or 4 inches wide, the miners use what is known among them as a "packer" or "poker." It is nothing more than a long wedge, and is common at St. Ives and at St. Just, and the peninsula of Land's End.

For purposes of comparison, the following table will be useful. It is compiled partly from the measurements of mining tools exhibited in the Museum of Practical Geology, attached to the Royal School of Mines, in London, as enumerated in the descriptive catalogue of that institution:

Dimensions of mining picks of several countries.

Length of handle.	Length of head.	Weight.		Description.
Inches.	*Inches.*	*lbs.*	*oz.*	
26.0	17.7	4	8	Cornish poll-pick for hard ground: Length over eye, 2.2 inches; of poll-end, 3 inches; of pick-end, 12.5 inches; thickness (depth) at poll-end, 1.2 inch; at pick-end, 1.1 inch; width over eye, 3.1 inches; at poll-end, 1.2 inch; at pick-end, 1.1 inch; poll-end 8-sided; point set at 85° to handle.
26.5	22.6	2	10	Cornish poll-pick for soft ground: Length over eye, 2.1 inches; of poll-end, 3 inches; of pick-end, 17.5 inches; thickness at poll-end, 0.8 inch; at pick-end, 0.9 inch; width over eye, 1 inch; at poll-end, 0.8 inch; at pick-end, 0.8 inch; point set at 83° to handle.
29.0	15.4	4	6	Derbyshire double pick, used in rock or vein, with short points.
29.0	15.7	3	10	Derbyshire "slitter," double, one side pointed, the other horizontal edge, 0.4 inch wide.
28.0	10.7	4	6	Derbyshire poll-pick, (mandrel,) short, bluff point; for hard veins and rock, where "slitter" is too slight.
25.0	18.9	4	6	Northumberland, double, straight-armed; arms thickened in the middle, like two gads.
29.0	15.2	5	2	Flintshire, single-pointed, with short 8-sided poll.
29.0	21.0	5	14	Flintshire, double; one wedge-point arm, the other with horizontal, chisel edge, 0.1 inch wide.
19.1	17.0	2	12	Monmouthshire (coal) cutting mandrels; straight, taper directly from center to points.
20.4	17.0	2	14	
33.3	19.0	3	5	Monmouthshire holing mandrel, stronger and bluffer.
33.8	19.0	3	5	
33.3	18.0	3	8	
30.0	22.3	6	6	Monmouthshire bottom mandrel; curved, double-pointed.
30.5	21.3	7	3	Monmouthshire bottom mandrel; curved, 2 chisel arms—1 horizontal, 1 vertical.
30.7	24.0	9	5	Monmouthshire rock mandrel; curved, 8-sided arms—1 wedge-pointed, 1 chisel end.
27.6	17.2	3	10	Flintshire (coal) metal-driving pick; tapered V cheek-pieces.
28.3	18.0	2	10	Flintshire (coal) holing pick; tapered V cheek-pieces; chisel-edged arms, 0.1 inch wide, with strongly curved top surface.
27.5	16.3	3	0	Flintshire (coal) heading pick; tapered V cheek-pieces; slightly curved; arms taper regularly.
32.0	17.8	4	5	North of England, (coal;) lower edge horizontal; top, 2 inclined planes; in plan, a lozenge, diminishing from center.
32.0	18.0	4	5	North of England; like the foregoing, except that the arms are bent or anchored, meeting at 155°.
30.0	19.7	7	0	North of England stone pick; slightly anchored; tapering V cheek-pieces; arms beveled to 8-sided sections, with 4-sided pyramid at points.
30.0	23.0	8	0	North of England stone pick; like the foregoing, but stronger and more anchored.
27.7	13.6	5	6	Saxon pick; single armed; tapered octagonal section; no poll; greatest thickness, 1.5 inch; breadth over eye, 2.12 inches; head set at 85° to handle.
20.5	15.4	4	3	Russian poll-pick; slender curved arm; length of pick-end, 12.8 inches; greatest diameter, 0.7 inch; eye circular.
20.5	12.5	3	6	Russian gravel pick; single curved arm; blade broadens to a spoonbill near the point.

It is curious to notice how great are the variations in this apparently trivial tool among different nations. Yet the proper form of a pick is not unimportant. If it only affected by a small fraction (and it does more than that) the amount of work which a laborer can perform daily, its aggregate importance to the effective daily labor of the world could scarcely be estimated in money. Our American patterns are so excellent, that there is little excuse for those who do not select the tool best suited to the work.

The Saxon gad resembles a long slender hammer. It is furnished with a narrow rectangular eye. When in use, it is held by a handle inserted into this eye, and is driven by striking the poll-end. A common size is, length of the iron, 6.2; of the eye, 0.86; of the handle, 14.0; breadth across the eye, 0.95; greatest depth, 0.7—all in inches. The point is formed by a small bluff pyramid, and the poll-end also contracts suddenly. Weight, 10 ounces. As the Saxon miners are enabled, from e fissured character of the rock, to make considerable use of these ds, they carry them under-ground in sets of a dozen or fifteen, strung by the eyes upon iron stays, with a joint or yoke in the middle, so that the whole may be slung over the shoulder, the gads being equally distributed before and behind. The gad passes over, as it were, by degrees into the pick. Thus the *fimmel* is a large hammer-like gad, weighing with handle, 2 pounds, 8 ounces, and having a head 10.2 inches and a handle 12.6 inches long. The small heavy poll-pick, weighing 7 pounds, 12 ounces, is very similar in form, but has a head 13.5 inches, and a handle 19 inches long. The ordinary German gads, and those of Hungary, are stronger and more hammer-like than those of Saxony. The Hungarian steel gads weigh 13 or 14 ounces, and the common gad 2 pounds 6 ounces.

HAND-DRILLS.

The hand-drills in California are made of English octagon steel, generally one inch in diameter for ordinary powder; sometimes, but rarely, 1¼ inch; and the striking hammers weigh from 8 to 10 pounds. For the new "giant powder" a three-quarter-inch drill is used, and the striking hammers weigh from 3 to 5 pounds. The use of proper copper-tipped tamping bars is rare, but safety-fuse is universally employed, so that the risk in using iron bars is somewhat diminished but is by no means removed.

The following pertinent observations upon blasting and hand-drilling are from notes of a lecture by Mr. Warrington Smyth, of the Royal School of Mines, England:

> The introduction of gunpowder has been an immense boon to mining undertakings. It not only enables the miners to work upon rocks of great hardness at an economical rate, but it has led to the enlargement of such excavations as drifts and levels, and so placed the workmen in a better position as to ventilation, comfort, and health. Formerly the miners, when cutting the rock, were compelled, by the narrowness of the levels and smallness of the working places, to inhale the dust made by themselves in piercing the rock, and their lives were shortened in a frightful degree. The mines, since the use of gunpowder, have had to be arranged with greater regard for ventilation, and the cylindrical holes for the gunpowder are now often, while being bored, kept full of water, and the old injury to the breathing faculties are for the most part avoided. There are, of course, occasions and places where gunpowder could not or ought not to be used. Where, for instance, fire-damp is common, and it is necessary to use safety-lamps, the lighting of a fuse with an open match will be most dangerous. In many collieries a certain man is employed to fire the shots, whose duty is to test the places beforehand, and see that no gases are present in quantities sufficient to take fire; but, as we all know, accidents do occur very often, and it is much to be desired that the practice should be greatly restricted, if not done away with altogether. Another case in which gunpowder should not be used is where the seam is much fractured and fissured naturally, so that a shot would result in so large a proportion of small coal as to make the working unremunerative. Again, its use is inadmissible in quarrying marble, or other stone, where it is an object to obtain the rock in large and perfect masses. The methods of employing gunpowder are, to a great extent, the same in principle in all the mining districts of the world. At first in this country, as elsewhere, boring the holes proved a slow and imperfect work, but, nevertheless, it soon came to be observed that by cutting away underneath, and then blowing the rock or seam down by gunpowder, one man could do as much as six with a hammer and gad alone. This, then, at starting renders it possible for a mine to be taken up and worked to profit which could not formerly have been done. The hole is bored, the powder placed in it, either loose or in a cartridge, it is then filled up, or "tamped," to the surface, and a fuse having been arranged, it is fired, and the result is that a portion of the rock is blown down. The hole is bored with what is called in different places a "jumper," a "drill," (Fr. pistolet,) or an "auger"—a piece of iron with a sharp steel ending called "a bit," which may be shaped in various forms, and then struck in the hole with considerable force and dexterity by the workman, until gradually a sufficient depth is pounded out. In most cases it is struck with a hammer wielded by the borer single-handed, but sometimes one man holds the jumper, and turns it after every stroke, while two men strike alternate blows, and thus greatly accelerate the work. The larger augers are usually from one and one-half inch to two and one-half inches in diameter, and in Germany it has been proved by experiment smaller bits are not advisable. The material of which

ese borers are made has been a question of great importance. About eighteen years go, the bar of the auger was almost always made of the best fibrous iron, the head eing of steel, and the bit or edge of the best shear steel. In Derbyshire, however, ey were accustomed to use cast steel, which in the fluor-spars usual there, of very oderate hardness, did very well, and lasted so long that borers bequeathed their augers o their sons; a very different state of things from that of other districts where an uger often would be worn out in a day. Cast steel, however, has been substituted enerally for iron; and that because it is not only more economical, but the blow given n the head of an auger of cast steel is transmitted so much quicker to the edge as to ive it a decided advantage over iron augers with steel bits. It had long been observed that when the borers had worked for some time with the iron augers some hange in the metal was produced, and the blow became more effective than at first. ince 1852 steel augers have, however, become general, in spite of their greater first ost. In a case in North Wales, where very accurate accounts were kept, it was found hat the use of steel borers decreased the cost of working nearly ten per cent. The orm of the cutting edge varies a good deal. When the ground is moderately soft, the rdinary chisel-shaped edge prevails. In the Hartz it is often curvilinear. In Italy he borers have two edges at right angles, while in Mexico they are swallow-tailed. n all cases, however, the borer must be turned after every blow through a small portion of the circle, so that the edge never falls upon exactly the same place. When the ottom of the hole is clogged with the debris produced by the cutter, the hole is filled ith water, which washes out a good deal, and a scraper takes out what is left.

There are many circumstances under which it is necessary to put down holes of a arger character; and then the augers are made larger and longer, and the hammers to trike it heavier. Stages are erected in such instances, so that on each stage several men may be placed to raise the auger, and thus a dozen men may at a word of command all lift and let go together. A jumper of this kind may weigh from two to three undred-weight. In cases of this kind the spring pole may be used to advantage. This brings us to the question whether or not machinery may be employed for the purpose of boring, and whether it cannot be done at a less expenditure of human labor, and more rapidly.

Among the mining tools that attracted some attention at the Paris Exposition, was an apparatus for enlarging the holes in rock made by an ordinary drill, the object being to secure an enlarged space or chamber at the bottom of the hole for the reception of the powder. The apparatus is described in full detail in the Exposition Reports; but as it does not appear to be of any practical value, it is not repeated here. It is, however, well to mention that, in 1864, a miner from Humboldt County, Nevada, made a drill for the same purpose and in a similar manner. It was known as Linscott's Patent Chamber Drill, and was made, and tested upon granite blocks, at San Francisco. It consisted of a bar of steel or iron, about two and a half feet long, with movable cutters, or steel blades, about two inches long, fitted into recesses, one on each side. These, when passed to the bottom of the hole, would fly out and cut upon the sides of the hole when the drill-bar was struck upon the top with a sledge. In this way, a chamber some three inches in diameter could be made at the bottom of an ordinary one or two inch hole.

The various forms of apparatus for drilling by steam-power or compressed air are described in another chapter.

CHAPTER LXVI.

EXPLOSIVES.

"Nothing is more surprising, considering how early gunpowder was vented and used for the purpose of piercing and shattering the bodies men, that so great a length of time should have elapsed before its plication to the purpose of blasting rocks in mining. The discovery gunpower for warlike purposes took place in 1354, but it was not induced into mining until the last century. In a curious old book, blished in 1700, entitled 'Familiar Discourse Concerning the Mine

Adventure,' which, among other things, compares the use of gunpow as a newly introduced system of blasting with the old method of w ing down the material in mines, its use for mining purposes is posed to have been first proposed at Freiberg, by Martin Weiga 1613, but the idea met with little countenance, and it was not till that it began to be generally employed throughout Saxony, the H and North Germany. The practice was first adopted in Englan 1670, at the Ecton Mines, in North Staffordshire, but the blasting at time was but a clumsy process, and was used to blow in pieces ma of rock which had already been freed from their beds by other agen We must not, however, be led astray by statements in books respe the earlier use of gunpowder in mines, as the older references to 'fir belong to the still more ancient practice of 'fire-setting,' which d from a very early period, and was, no doubt, employed by the Roma

Even so late as the year 1862, gunpowder had not been introduce mining in Japan, and it was introduced there for the first time by Pumpelly and the writer, acting in the capacity of mining enginee the Japanese government. Up to that time the miners of Nipon Yesso had cut their way through the rocks by means of the pick gad, aided sometimes by fire, and they were very greatly astonis when they saw the hard rock at the end of a drift, abandoned by t because it was too hard to cut, thrown down by means of a few ou of powder.

The consumption of powder for mining purposes upon the Pa Coast and in our mining Territories has always been large. A pa this is of course used in the construction of roads and grading for ways, but of late the consumption for breaking up the hard ceme conglomerates of the deep placer deposits has greatly increased. this purpose very heavy charges are employed. Tunnels are drive wards for 40 to 70 feet from the face of the bank, and cross-tunnels for 100 feet each way, so that the excavation has the form of the le T. A charge of from 100 to 500 kegs of powder is placed in the c tunnel, and the whole is simultaneously ignited by electricity. effect is to lift the whole deposit, and to shatter and loosen it to su degree that the rest of the disintegration is readily effected by wate

Two companies, with adequate capital, are organized for the manu ture of powder in California. The demand for powder for those reg which usually draw their supply from California, is reported to siderably exceed 200,000 kegs annually.

The works of the California Powder Company are the only ones in operation. At the mills of this company, situated at Santa C there were manufactured as stated in the following table:

Powder manufactured in California.

Year.	Blasting powder. Kegs.	Sporting, cannon, and musket powder; equivalent to kegs.	Total.
1867	150,454	7,269½	157,723½
1868	63,033	6,871½	69,904½
1869	130,151	2,439	132,590
	343,638	16,580	360,218

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* From notes of a lecture by Mr. Warrington Smyth, at the Royal School of M London Mining Journal, January, 1870.

Besides the above there has been some powder made at the Marin lills, probably not exceeding 30,000 kegs of blasting powder, in the years 367 and 1868. With the facilities now possessed by the California ompany, they can turn out 640 kegs of powder daily. The kegs conain 25 pounds each.

The materials for making powder are abundant and accessible in Calornia, with the exception of niter, which is to a great extent replaced y nitrate of soda from Peru. The peculiar dryness of the air in Calornia for the greater part of the year permits this more deliquescenc alt to be successfully used; and, with proper precautions in the manuacture, it makes excellent powder. The capacity of the two mills is ver 1,000 kegs of powder daily. A recent modification of the manuacture promises important results. Glycerine is added to the grains in ome way not yet made known, and it is said to greatly increase the trength.

Works for the manufacture of safety-fuse have recently been erected n San Francisco, so that the miners can now obtain an article superior o that which is imported.

Notwithstanding the familiarity which all who use powder must gain rith the many causes of accident, it is extraordinary that there should ontinue to be so much carelessness and recklessness in its use. One f the British mining inspectors says that in blasting an iron instead f a wooden or copper rammer is still too often used in getting the radding and first part of the stemming fairly bedded upon the powder, nd shots which have missed fire are still drawn, although experience hows that, even with water in the hole, the drill goes in advance and res the powder. Accidents are also frequently caused by driving the ricker down into the powder.

The mineral statistics of Victoria, Australia, give exact returns of he quantities of gunpowder issued at each of the mining districts where here are magazines. In the year 1867 the quantity in stock, at the ommencement of the year, in all the districts was 71 tons 16 hundredeight; the quantity issued during the year, 196 tons 13 hundredeight; the quantity received during the year, 186 tons 12 hundredeight; and the quantity in stock at the end of the year, 61 tons 15 undred-weight. In many parts of the colony, however, there are no agazines, and great quantities of blasting powder are used there, of hich there is no accurate return.

NEW EXPLOSIVE COMPOUNDS.

In introducing the subject of the new explosive compounds, which are ow attracting much attention from engineers and miners, I cannot do etter than to cite from the authority mentioned at the commencement f this chapter:

> Of all explosives used for blasting powder is the most largely used, and continues to the most popular. It has been, however, proposed, and that many years ago, to ingle with it various substances, and it has been tolerably well made out on the Coment that the effects of powder have not been deteriorated by a moderate proportion sawdust being mingled with it. Within comparatively a very few years propositions ve been made to completely change our explosive agents—as, for instance, by gunton, which seemed to be peculiarly adapted for blasting purposes. It is difficult to ter upon the comparative merits of different classes of explosives on account of the at jealousies which are indulged in respecting them. This is the case even with wder, every separate manufacture of which has its advocates. Gun-cotton has, howr, been most successfully employed in many places, among which may be mentioned important quarries of the Austrian government up the Danube. In England an imvement in its manufacture was made some time ago, by which it is produced in the

form of a rope, and can thus be cut off into convenient lengths. By the newer method, manufactured on a considerable scale by Messrs. Prentice, of Stowmarket, it is made into a pulp, and then compressed so as to take up less space. But even in its rope form gun-cotton has an advantage over gunpowder, as, taking weight for weight, it will do five or six times the work of gunpowder. Besides this, six ounces of powder will occupy eight inches of a bore-hole of given diameter, while one ounce of gun-cotton, which has the same explosive power, will take up only five and a half inches. Then, gun-cotton makes little or no smoke, although the small vapor it leaves is deleterious, if it may be judged by the sensation of headache and dimness of eyes, which it produces. Another important explosive is nitro-glycerine. A year or two ago I might have said a good deal as to its coming into play with advantage, and its general adoption in this country, particularly in North Wales, where it was much used. Indeed, in some mines and quarries, when it was left optional with the men (who for the most part are a careful race, and to be trusted in such matters) to use either gunpowder, nitro-glycerine, or gun-cotton, a considerable proportion preferred nitro-glycerine. They not only found that its explosive force was tremendously greater, but that it was more convenient. Thus, when the bore-hole was completed it had only to be filled full of water, and the nitro-glycerine poured in. By its greater specific gravity the latter sinks to the bottom, and then the introduction of the fuse, in connection with a copper cap at the bottom, was attended with no difficulty or danger, and the results of the explosions were tenfold. Unfortunately, the carelessness of those who had charge of nitro-glycerine gave rise to fearful accidents last summer, and in a sudden panic, as it seems, an act of Parliament was passed, which has practically made its use penal. It is true those who want to use it are allowed to make it on the spot, but every one knows that that permission is of little value, since its manufacture requires a good knowledge of chemistry. Mining agents and managers, therefore, very naturally get rid of the difficulty by giving up its use, and for the present, therefore, in this country it may be said to be tabooed. If, however, the risk attendant upon its conveyance can be got over, it seems a great pity to shut out from mining operations a blasting agent of such enormous power and utility. It has, therefore, been prepared in the form of a powder, called "dynamite," the invention of M. Nobel, of Hamburg.

Before giving a description of this new material, now largely used upon the Pacific coast, the nature and properties of nitro-glycerine will be briefly noticed.

NITRO-GLYCERINE.

Nitro-glycerine was discovered in 1847 by M. Sobrero in the laboratory of Professor Pelouze; but public attention was not directed to it as an explosive until the labors of M. Nobel, a Swedish mining engineer, were made known.

This liquid is obtained by the action of concentrated nitric acid, or of a mixture of nitric acid of 40° strength and sulphuric acid of 66°, upon glycerine. It is formed like pyroxyline, and is, in fact, a trinitrate of glycerine; the reaction being represented by:

$$C^6 H^8 O^6 + 3 NO^5 HO = C^6 H^5 O^3 \; 3 NO^5 + 6 HO.$$

It is a yellow liquid, resembling olive oil, without odor, and possessing a sweet, slightly fragrant taste. Taken into the stomach or absorbed through the skin, as of the hands, it is poisonous, and its vapors give violent headaches. It is soluble in alcohol and ether, but not in water.

It can be heated up to 212° Fahrenheit without decomposition; but at about 360° it detonates with extraordinary violence. It detonates when struck by a hammer on a hard surface or even upon wood, and the mere opening of a wooden box in which tin cans of the oil were packed has been known to explode it.

Pure nitro-glycerine does not appear to be liable to explode spontaneously, but if impure and acid it changes into a mixture of oxalic acid and glycerine, and may explode.

Of gunpowder, according to theory, only 50 per cent. is converted into gas, one volume giving 260 volumes of cold gas, deduction being made for the expansion produced by heat. Practically, however, the combustion is never so complete, and 200 volumes of the cold gas are, therefore, in all probability, above the average result.

In the combustion or explosion of nitro-glycerine seventeen equiva-
its of oxygen out of the eighteen are absorbed by combining with the
rbon and hydrogen, thus leaving one equivalent of oxygen free. Each
e hundred parts of the oil when exploded produce by weight:

ater	20.0 parts.
rbonic acid	58.0 parts.
ygen	3.5 parts.
trogen	18.5 parts.
	100.0

And, as the specific weight of the blasting oil is 1.6, one volume pro-
ices:

eam	554 volumes.
rbonic acid	469 volumes.
ygen gas	39 volumes.
itrogen gas	236 volumes.
A total of	1,298 volumes

It is assumed that the heat generated by the explosion of nitro-glycerine
at least twice that generated by gunpowder; consequently, if a volume
f powder gives 200 volumes of cold gas, expanded by heat four times
800; a volume of nitro-glycerine gives 1,300 volumes of cold gas, ex-
anded by heat eight times, producing 10,400 volumes; so that nitro-
lycerine possesses about *thirteen times* the power of gunpowder when
olumes are compared, and eight times its power for equal weights, the
pecific gravity of powder being taken at 1.0.

It is claimed by the agents for the article in San Francisco that one
ound of the blasting-oil will produce effects equal to ten pounds of gun-
owder. The first requires but one bore hole, whereas for the powder
bout ten holes of the same dimensions will be required.

But the sad experience with this dreadful explosive has been such as
prevent its general introduction in mining. Californians will never
rget the destruction of life and property which a single box of it
ought in an instant at the office of Wells, Fargo, & Company in
n Francisco. This, and the destruction of a vessel at Aspinwall, and
veral other dreadful accidents in various parts of the world, have been
practical refutation of the theories of the comparative safety and
rmlessness of the oil under ordinary circumstances of storage and
ansportation. These accidents, showing the impossibility of controlling
is agent of such wonderful power, led to the introduction of a modifica-
n of it in the mixture now known as *dynamite*, or "giant powder."

GIANT POWDER OR DYNAMITE.

The invention of this compound dates from 1867, and it has been in
e for nearly two years at some of the mines upon the Pacific coast.
is formed by mingling nitro-glycerine with infusorial earth, and it re-
mbles moist sawdust in appearance. A company has been organized
its manufacture in San Francisco, and the consumption of it is steadily
reasing.

The following descriptions of the powder, its properties, and the
ethods of using it have been supplied to me by the general agents for
e Pacific coast, Messrs. Bandmann, Nielsen & Co., of San Francisco:

eneral properties.—It is an ungrained powder, of a grayish brown color, with a
ecific gravity of about 1; insoluble in water, and not affected by time or exposure
air or moisture. It congeals at about forty-two degrees Fahrenheit. It sometimes

produces a temporary headache when taken into the mouth or stomach. The same effect also follows its continued handling. In the open air, or in ordinary packing, it burns without exploding. Its combustion produces carbonic acid, oxide of carbon, hyponitrous acid, and water.

There are three, and only three, methods of exploding it: 1st. By a violent explosion either in it or into it. 2d. By confining it in a very strong and tight vessel, and setting it on fire, or heating the vessel sufficiently. 3d. By a percussive shock so intense as to produce heat and violence equivalent to an explosion. Unlike gunpowder, its explosion is instantaneous—the entire mass of powder explodes as if it were a single grain. This quality, in connection with its extraordinary evolution of gases, causes its explosive effect to be especially great in solid substances, so much so that the powder cannot be used in ordnance or fire-arms, the gun being blown to pieces instead of being discharged. Its explosion produces carbonic acid, nitrogen, oxygen, and water.

Packing, transportation, and storage.—The powder may be packed, stored, and conveyed in all the ordinary ways. The fact that the powder is explosive, naturally suggests the idea that it is dangerous; but it is in reality no more so than corn meal. Practically, it cannot be exploded by accident. It requires design and careful preparation to explode it. The only practical caution necessary is to keep other explosives away from it. Fire alone will not explode it, nor heat in any form—they will burn it to ashes, like saltpetre paper, without exploding it. Nor will any amount of mere weight upon it, or simple pressure of any kind, explode it. It cannot be exploded by any of the ordinary movements, accidents, or incidents which attend its handling, transportation, or use. The pressing it into cartridges, or ramming it into bore-holes with a wooden rod, however hard, throwing it about, or jostling it in transportation, or even the crushing or violence of overturning wagons, collisions of cars, or explosions of boilers, will never explode it. But heat and pressure combined will explode it, provided they are of the proper kind and degree. It is exploded by any violent explosion either in it or into it, whether of gunpowder, fulminate, nitro-glycerine, giant powder, or other violent explosive. Such an explosion involves the peculiar percussive pressure and heat necessary. The burning or flashing of gunpowder unconfined is not sufficient.

Another method of exploding it is to set it on fire while under confinement in some tight and strong vessel. The burning of the powder produces gases which, finding no escape, at length cause a pressure so great as to produce, with the heat of the burning, an explosion of the unburned powder. By tight and strong vessels is meant iron retorts, quicksilver flasks, gas-pipe, with caps screwed to its ends, and the like. A vessel of the strongest tin has not the requisite strength; this, like cartridges of paper, ordinary packing-boxes, barrels, casks, &c., will be burst asunder by the gases before the pressure is sufficient to cause explosion. These are the only known means of causing an explosion proper, but a partial explosion can be produced by causing a very thin layer of powder to be struck with great force between hard and smooth surfaces, as, for example, striking a minute quantity with a hammer on an anvil, or driving an iron plug upon it in a hole drilled in the iron. In these cases, a slight explosion and detonation follow, but not of sufficient force to explode any part of the powder present, except the few particles in immediate contact with the impinging surfaces.

Utensils for blasting.—Except in special cases, it is better to use the powder in the form of cartridges. It is more economical in both time and powder, and the explosion is more certain. Cartridges of various sizes are prepared and sold by the company. Should others make them, let it be done with strong material, well glued or pasted together, and let the powder be very firmly pressed into them. Cartridges may be cut into such lengths as may be required, care being taken to prevent the loss of powder by rolling the sections in additional paper, or otherwise. Ordinary blasting fuse may be used, but to make sure of a discharge in all cases, and to keep the powder from being burned by fire from a leaky fuse the best gutta percha fuse is recommended, and of a size to fit the caps precisely. Caps manufactured for the special purpose of exploding giant powder are furnished by the company. Common percussion caps cannot be used. As these special caps are more heavily charged with fulminate than ordinary ones, corresponding care should be taken in their handling and use. A pair of cutting nippers, with their edges blunted, used in securing the caps tightly and firmly to the fuse. A tube with a funnel mouth will be useful in charging with loose powder. Tin tubing in sections may be useful in guiding cartridges into submarine bores.

Drill holes, charges, &c.—As to the diameter and depth of holes, and where they should be made, and the direction they should take, and also as to the quantity of powder to be used, and many other matters, no definite or arbitrary rules can be laid down for blasting with any explosive. In these things there must be variation according to the location, character of the material to be blasted, the purpose of the blast, and other circumstances too numerous and complicated to anticipate. Much must, therefore, be left to the good sense and experience of the blaster. The following observations and examples will afford some assistance to a beginner:

As a general rule, the drill holes and charges for giant powder can be, and should be,

aratively small. Experience has proven that ¾ inch octagon steel with 3½ pound
ers, used by single hand drillers, are best adapted to use the powder to the
st advantage. Holes one inch in diameter are abundantly large for all ordinary
work; for light work, correspondingly smaller ones should be made. A small
ity in a deep hole, whether the hole is large or small; also, a small quantity in
e hole whether the hole be deep or shallow; also a large quantity in a small but
hole; also, a large quantity in a large but shallow hole, are all examples of misap-
ions; they are all violations of the general rule applicable to all explosives—that
antity of powder should not only be proportionate to the resistance, but the hole
l be proportionate to the powder.

by reason of its quickness giant powder in bore holes is nearly as effectual with-
mping as with it, it can be exploded with great advantage without any tamping
in natural fissures and artificial cracks. It is therefore urged that advantage be
of this extraordinary quality as often as practicable.

ing to the great difference in the capacity between the old and new powder, the
ncy will be to overcharge; it is therefore recommended that each blaster experi-
on this point, so far, at least, as to ascertain the minimum quantity of powder
will answer his particular purpose.

mples.—A solid cast-iron ball, seven inches in diameter, charged with half an
of giant powder, in a three-quarter inch hole, three inches deep, without tamp-
ill be blown into small fragments. The same result will follow the explosion of
quarters of an ounce at the center of a wrought iron anvil. A six foot cube of
granite charged with an ounce of giant powder in a three quarter inch hole, nine
deep, will be cracked into several pieces. Boulders three or four feet in diame-
d particularly flat ones, can be cracked in pieces by exploding an ounce or two
wder on their surfaces. An ordinary rifle will be blown to pieces by a charge of
powder of one-half of the weight of an ordinary charge of gunpowder. A charge
n one to two pounds of powder in an inch hole from five to ten feet deep, placed
fifteen feet back from the face of the wall, in hard rock, will crack off or shatter
hole intervening mass.

rging.—The charge in the form of cartridges must fit and fill the bottom of the
and be packed solid. This is an essential prerequisite to an effective blast. The
ray to secure it is this: Take a cartridge, as near as possible, of the same size of
re, and cut it into sections from one to two inches long. With a hard wood ram-
s long as will run freely in the hole, press these sections into the bore hole one
e with sufficient force until each section is driven to the bottom and expanded
lly, so as to fill the hole solidly in every direction.

r sized cartridge may be used, provided it is thus put in. Metallic rammers must
used. In wet holes the sections of cartridge should be rolled in additional
, and the ends closed to prevent the powder from getting mixed with water. In
mines the giant powder is used *loose* in downward holes. It is poured through
nneled tube into the drill hole. Economy requires that the tube should reach
r the bottom of the hole. The charge should be rammed down in divisions, sub-
ally as directed as to cartridges.

sing.—After charging the bore, cut off a proper length of fuse and insert its end
ne of the special caps up to the fulminate. If the fuse is too large for the cap
t to a fit; if too small, wrap it with paper. But the difference between the size
fuse and the caps should be very slight. Then place the edge of the nippers
the cap near its edge, and indent it firmly into the fuse. Never do this with the
Now cut off about one inch of the smallest sized cartridge, and roll it in ad-
al paper, and insert the cap with the fuse attached into the powder about the
h of the cap, and press the powder firmly about the cap. Then close the neck of
rtridge about the fuse, and fasten it there by a strong string, or some other means,
h a manner as to prevent the cap from being withdrawn from the powder. To
sure that the cap and cartridge do not get apart, it is better, in all cases, not
o tie the cord about the neck, but also to tie the ends afterwards around the
l fuse close to the mouth of the cartridge. This is called the primer.

s prepared, place the primer in the drill hole, and press it with the hand or a
n rod into contact with the charge.

sing loose powder, if it is within reach of the hand, instead of using a primer a
d fuse can be used to explode it, taking care to press the powder around the cap,
cure the fuse in place by putting a stone upon it, or otherwise.

ping.—After priming, fill the bore hole with water whenever it can be done, and
it cannot, blast without tamping.

sidering the slight advantage of any other than water tamping, the time taken
ly it, the danger of disturbing or exploding the cap, and the inconvenience of re-
ng in case of miss-fire, it is better not to use it.

losion of blasts.—The burning of the fuse explodes the cap; the explosion of the
plodes the primer or charge in which the cap may be. All the other cartridges
rges in the same hole are exploded by the first explosion of powder.

In case the blast misses fire, put in another primer.

A space of several inches, either vacant or filled, between several charges or cart in the same hole, will not prevent the simultaneous explosion of all. In case the is not effective, it will be because our directions have not been followed, or becau blaster has erred in some matter left to his discretion. The most common cau failure are deficiency of powder and defective ramming.

It may be stated here that the great advantage claimed for this powder consist so much in diminishing the cost of powder as an item of expense as in diminishi cost of using it. The difference in the cost of powder is trifling in comparison wit difference in the cost of drilling, charging, tamping, convenience in wet work effectiveness of blasts. Giant powder, as a general rule, throws rock less and b it more, and extends its effects much deeper than ordinary blasting powder; and who use it soon learn not to judge of a blast by first appearances. It frequently pens that a blast which seems to have had no effect proves to have done remar execution in cracking and loosening the rock, and preparing the way for subse blasts. This is especially the case in tunnels and shafts.

Blasting under water.—Cartridges to be used in water should be made of such as will not be destroyed or materially weakened by the water. They should al weighted with sand in their bottoms, or in some other way, so as to sink. To as are not thus weighted, in water, they must be forced to their places, and fast there by pouring sand upon them or otherwise. In submarine work, where the b at a considerable distance below the surface of the water, the tubing, in sections be used to guide the weighted cartridge to its place.

If submerged rocks have to be removed, all that is required is to take a large or s box of giant powder, in bulk, as the case may be; bore with a gimlet a hole into the fasten, as before mentioned, the cap well to the fuse, and push the cap through the its length into the powder, never further; tighten the gimlet hole with some grea wax; tie additional weight to the box, light the fuse, which only requires suffic length to allow the box time to reach the rock when sunk, and drop the same on rock to be blasted. Some use special submarine fuse, which withstands the pres of the water to any depth. In this way the entrance to the great San Francisco dock has been cleared from rocks, under the superintendence of the late efficient e neer, Mr. Pollock. As much as one hundred and twenty pounds of black powder at blast were lowered, more than once, on a certain rock near or in front of the dry d and exploded, and nothing was effected but throwing up a beautiful column of wa Mr. Pollock sunk on the same rock a box with ten pounds of giant powder, and the blast shattered the rock to pieces. Six-pound boxes were then used, Mr. Pollock f ing the enormous effect of larger blasts might injure the dry dock proper; even t blasts proved too powerful, and at last only two-pound boxes were used, which suc fully removed all the rocks.

Temperature.—Below 42 degrees Fahrenheit giant powder freezes, and above degrees (the boiling point of water) it throws off noxious fumes, and becomes w ened and finally destroyed. It should, therefore, be kept in some place having a t perature between these extremes. When frozen, it can be thawed by being kept f time in this proper temperature. When it becomes soft to the touch it is ready for As it freezes very slowly, no inconvenient haste is required in its application. If powder in boxes or cartridges has from accidental causes become wet, if dried a slowly its usefulness is not impaired.

Effect of the giant powder on the health.—Some miners suffered from headache when powder first came into use; but this was caused by the impossibility of procuring raw material at the beginning of the business in a pure state. This has long ago obviated, and since that time we hear of no complaints of headache, except prod by some of the following causes. We have numerous affidavits from miners th never affected them, and that they never suffered any headache from its use. causes which can produce a temporary headache are the following: Either handling the powder too much, tasting it and rubbing it between the fingers afterward unconsciously rubbing the face with the hands, when not used to from going immediately after a blast into a badly ventilated tunnel or shaft, wh invariably done by new consumers, to see the effect produced by this new bla agent. The enormous power of the giant powder in its explosion drives away short while the little good air which is at the end of a tunnel; the space is then tially filled with gases. In case the charge is not entirely exploded, but part of it b this burning of the powder creates the noxious fumes which cause headache; o fumes are caused by improperly securing the cap to the fuse, and the cap and fi the primary cartridge. It is of very great importance that this should be done erly. Those who are familiar with its use never experience any inconvenience fro use when the whole charge is properly exploded. A little quicklime placed ne hole to be blasted, or some ammonia placed in a vessel near the blast, will absorb gases in a few minutes. If men not accustomed to this powder will stay out o shafts or tunnels which are badly ventilated, after the blast is exploded, only on

the time they do after black-powder explosions during the first few days, no com-
ints of headaches would ever arise. It may not be generally known, but it is never-
less a fact, that if black powder produced no smoke, (which forces men to stay out
ertain time.) and they should go in immediately after a blast, they would experience
same headache. This is sufficiently proved by persons of science. The gases lib-
ted by exploding giant powder are carbonic acid gas, oxygen, nitrogen, and steam,
l those from gunpowder are the same; but gunpowder, in addition, has carbonic
de.

Pipe-clay bank blasting.—It has so far been a very expensive operation for the miners
break up pipe-clay and cement banks to enable them to extract the gold by sluicing.
ng tunnels had to be run, with a T at the end, in which were placed from fifty to
e thousand kegs of common powder; the tunnel was then filled up again and the
nt fired. The bank was always thrown over in large pieces of clay or cement, which
re afterwards broken to pieces by picks and gads, and often with small blasts—a very
borious and expensive proceeding. Recently, in this kind of work, giant powder has
en introduced, which overcomes all difficulties, and shows itself so far superior to the
d process, and saves so enormously in cost, that it cannot fail to be speedily intro-
ced in all bank blasting work. In a bank of pipe-clay about seventy feet high a
le six inches in diameter was bored horizontally, with an auger, twenty-six feet deep
d a few feet above the ground. Into this hole one hundred pounds of giant powder,
cartridges six inches in diameter, was introduced and well rammed, and the blast
d. The result was surprisingly successful. The blast did not throw the bank over
o enormous pieces to be broken up again, as is always the case where black powder
sed; but the blast crushed and crumbled the entire bank, seventy-five feet on each
of the blast, in such a manner that when the water is turned on it can all be
bed down without additional work.

se in vein mining.—The giant powder has been in use for nearly two
rs at the Oakes and Reese mine, in Hunter's Valley, near the Mari-
a Estate. A letter from there, January, 1869, is as follows:

> e have used the powder entirely since last April. In its use the steel consumed is
> niform size—three-quarter inch octagon. Hammers (short handles) weighing three
> a half pounds. The country rock is hard and tenacious. The veins of quartz are
> ow, varying from ten inches to three feet, generally running from one foot to twenty
> es in width, with little or no gouge.
>
> he system which Mr. Cassel, superintendent of the mine, has introduced, (and
> ch can only be used to advantage with giant powder,) is to pay the miners by the
> in depth of hole drilled—the miner doing no blasting, nor does he handle any rock,
> simple duty being to drill holes where instructed.
>
> he underground superintendent or head blaster—one for each shift—instructs the
> er where to drill a hole. When the hole is drilled to the depth required the super-
> ndent measures it and takes a memorandum of the same, and sets the miner at
> k elsewhere. As soon as the hole is measured the blaster loads it with from two to
> and a half ounces of loose powder, fills the hole with water, covers it, and leaves
> ntil the men leave it at time of shift. As soon as the men have left the mine, the
> ter with his fuses, with cap or exploder attached, makes his round, and, removing
> cover from the hole, drops the fuse into the hole, works the exploder into the pow-
> which is quite soft, fires the fuse, and in a few minutes will explode all the holes
> led during the working shift. As soon as the explosions are made the rock men
> skip men clear away the debris which may be in the way of drilling new holes,
> when the men again come into the mine there is work for them ahead in drilling.
> ast is only fired when the men are at work on the mine when it becomes necessary
> move material. Thus it will be seen no time is lost in blasting.
>
> y experience since April last leads me to know the following facts in the use of
> t powder as against gunpowder:
>
> rst. The amount of work which can be performed in a given space in a mine is
> ly double.
>
> cond. The consumption of steel is about one-half.
>
> ird. The consumption of hammers is about one-half.
>
> urth. The consumption of candles is about one-half.
>
> fth. The width of the drifts or stopes is only about one-half, requiring so much less
> rial to be removed or hoisted from the mine.
>
> th. The mining timbers are shorter.
>
> venth. The ore raised from the mine is broken by the force of the powder so as to
> ire less spalling for the mill.
>
> ghth. The progress of the work in the mine is expedited at least forty per cent.,
> n wet mines the progress is increased fully fifty per cent., if not more.
>
> * * * * * * * * * * *
>
> far as the miner is concerned, he can earn more money with a three-quarter-inch

steel and small hammer, than in any other way. It is true he must earn his mo and is not paid by the day. The price paid in the Oakes & Reese mine is 37½ ce per foot of hole drilled. In October, there was drilled 6,476¼ feet of hole, costi $2,429 03. The following list will exhibit the amounts earned by miners most exp in the use of single-hammer drills in October, twenty-seven working days.

P. Beicai	$130 20	H. Laity	$97
L. Boivin	124 33	F. Gill	94
J. A. Wilson	131 77	F. Lastrade	90
B. Kendall	103 77	J. Fortuna	94
S. Cox	122 25	H. Boyle	91
S. Uran	130 74	J. Martin	90
B. Picard	104 50	L. Battiola	84

and many others ranging below the above amounts, falling short either because n working full time, or from not being expert in use of the single hammer. Still, a system of mining where a miner willing to work can earn as high as $131 77 per mon of twenty-seven working days, must inure to the benefit of the miner, and particular so when the mine owner is willing to pay such wages. One thing is certain, that wi giant powder and the use of small steel and hammers, the miner must earn his mone and cannot shirk his work, as is too often the case under the old system of mining.

Mr. L. L. Robinson, the president of the Giant Powder Company writes under date of January 25, 1869, to the Mining and Scientifi Press, as follows:

EDITORS PRESS: Noticing in your paper of the 16th a communication having refe ence to the use of giant powder in the Oakes & Reese mine, belonging to Mr. McAllis and myself, I beg to state that during the past week our superintendent, Mr. Ca has let the following contracts for work on the mine:

1. Sinking the main shaft 50 feet from the 278-foot level, at $60 per foot—contracting parties furnishing everything.
2. Drift west, on Oakes & Reese vein, 50 feet, at $13 per foot—contractors furnishing everything.
3. Drift south, 50 feet, at $10 75 per foot.

The same work has heretofore cost us, with the use of black powder, as follows:

1. Sinking main shaft, $90 per foot.
2. Drift west, Oakes & Reese vein, $30 per foot.
3. Drift south, blue lead, $25 per foot.

Thus it will be seen that in these three contracts the mine owners save as follows:

1. Sinking 50-foot shaft, at $30	$1,500 0
2. West drift, 30 feet, at $17	[illegible]
3. South drift, 50 feet, at $14 25	712 5
Total saving	3,062 5

In addition to the saving in dollars and cents, is also the important item of saving i time, as the time occupied in finishing contracts with giant powder is only about one half the time required with use of ordinary powder.

The contractors, even at these low rates, are better satisfied with the prices than under the old prices with the common powder.

Giant powder for railroad work.—The Central Pacific Railroad Company, in running their long "Summit Tunnel," commenced the use of nitro-glycerine, and found it s very effective and advantageous that they were enabled to complete the tunnel in one one year less time than if ordinary powder had been used.

How much this saving of time of over one year has been worth to the Central Paci railroad can hardly be estimated. It is well known that giant powder possesses abou the same strength as nitro-glycerine, without any of its dangerous qualities. At th time the above work was done, giant powder had not been invented, otherwise it wou undoubtedly have been preferred to nitro-glycerine. The Western Pacific Railro Company, the Oregon Railroad Company, and the Virginia and Truckee Railroad Com pany have used, and are using, the giant powder.

In conclusion, Messrs. Bandmann, Nielsen & Co., give the annex recapitulation of the chief advantages attending the use of the gia powder:

1. A great economy in labor for boring.
2. The rapidity of blasting operations, which is of vital importance, especially i mines and railway tunnels, can be made with giant powder in one-half the time, o less, than with black powder.

3. Perfect safety in carrying, storing, and handling it.

4. A complete combustion, which leaves no smoke or noxious gases.

5. The quickness of explosion is so great that fissured rocks and clay are easily blasted th it.

6. Great saving in wear and tear of tools, and in consumption of steel and fuse, fewer re-holes being needed.

7. No tamping but water or loose sand being required, the loading is attended with risk, but with a saving of time and expense.

8. In boulder blasting in gravel claims it is very superior, as in all ordinary boulders, large to be easily removed by manual labor, a small charge of giant powder in a le made with a half-inch drill and three-pound hammer, will shatter the boulders so ey can easily be handled.

9. Its use under water or in water-bleeding rock is very simple and the effect very eat.

10. It is very useful for blasting heavy blocks of iron, steel, or metal, which cannot blasted by gunpowder, but easily yield to small charges of giant powder.

11. For military purposes, in springing mines and removing palisades.

A fair trial never fails to prove a complete success. The first blasts are conclusive as the great superiority of giant powder over gunpowder, but its full economical value n only appear when those who use it use single-handed drills, and at the same time in experience enough not to waste its power by overcharging or requiring imposbilities of it.

The consumption of giant powder in California is reported (1869) to ry from 12,000 to 15,000 pounds per month, and to be increasing.

EXPERIMENTS WITH GIANT POWDER.—In offering the giant powder to e several steamship, steamboat, railroad, and express companies to be nsported, some doubts were expressed as to its safety; invitations were erefore given to several officers of these companies to witness a few periments with the powder, designed to test its qualities in this reect and satisfy such doubts.

Accordingly, on the 27th day of March, 1868, near the company's rks in San Francisco, the powder was subjected to the following tests, the presence of Charles E. McLane, of Wells, Fargo & Co.; C. J. enham, of the California, Oregon and Mexico Steamship Company; M. Hartshorne, of the California Steam Navigation Company; W. M. ughes, of Hughes & Keys, of Stockton, and several other gentlemen. e following is the record of results:

First Experiment.—A box strongly made of ¼-inch pine boards, and filled with about 3 s. of giant powder, firmly packed, was thrown from a perpendicular height of 30 feet on a rock. The end upon which the box struck was broken in and the powder conlerably displaced and compressed, but not exploded.

Second Experiment.—At the suggestion of Mr. McLane, 8 cartridges, each containing unces of powder, were firmly bound together with a strong cord and thrown repeatly from the same height upon the rocks below. Several of the cartridges were innted, bent and bruised, but not broken. Finally the cord was cut by the rocks and e cartridges separated. No explosion.

Third Experiment.—A similar bundle of cartridges was placed upon a large rock, with a ugh surface, and heavy stones, weighing from 10 to 30 lbs. each, thrown from the me height upon it. The cartridges were flattened and broken open, and some of the wder spilled and ground into the rock. No explosion.

Fourth Experiment.—A box of the same size as in the first experiment was filled partly ith cartridges and partly with loose powder. A common fuse, without any cap, was serted in the loose powder, and the cover of the box screwed on and the fuse lighted. e loose powder was set on fire, causing a formation of gases, which forced the boards art, and escaped with a hissing noise like steam. There was no explosion. The loose wder was burned while the cartridges were unaffected except by being scorched. In is state one of the cartridges was taken from the box and exploded in the ordinary anner, with terrific effect.

Fifth Experiment.—A similar box was now filled with cartridges, from which Captain enham selected one at random, for the purpose of testing it. The box was then osed tightly, and placed upon an open fire and consumed, powder and all, without exoding. During the burning, slight noises were heard from time to time, indicating e bursting of the cartridges. The cartridge selected by Captain Brenham was now ploded in the usual manner, with the usual effect.

Sixth Experiment.—A heavy tin cylinder, 1 inch in diameter and 8 inches long, was cked full of loose powder, a fuse without a cap inserted, and the end of the cylinder then tightly plugged. A small portion of the powder about the fuse was burned, the plug forced out with a noise like the drawing of a cork, and the fire extinguished. The cartridge was then thrown into a fire and consumed without exploding.

Seventh Experiment.—Six cartridges, each containing 4 ounces of powder with a capped fuse in one of them, were placed 2 or 3 inches apart in a horizontal crevice in a cliff of hard rock, without tamping or other means of confinement. The cartridges were all exploded together; there was but a single report. The bluff above the crevice, to the extent of many tons, was completely shattered.

Eighth Experiment.—The box of powder used in the first experiment was now placed on a flat, hard stone, about 9 square feet surface, and fifteen inches thick, and exploded in the proper manner. The rock was broken into fragments, none of which was larger than a man's fist, and the ground was torn up and blown out to a considerable depth.

Ninth Experiment.—Two handfuls of loose powder were exploded upon a rock similar to that in the eighth experiment, but imbedded in the earth. The portion of the rock above ground was crumbled into small pieces, while that below was cracked and shivered in every direction.

Tenth Experiment.—A section of 2-inch common gas pipe, about 4 feet long, was placed upon the ground, a 2-ounce cartridge inserted loosely in each end, leaving the tube between the cartridges—a space of about 3½ feet—entirely empty. In one of the cartridges was placed the usual fuse and cap and nothing in the other. No tamping was used, or other filling or fastening. The ends of the tube were not more than half filled by the cartridges. Both cartridges exploded at once. Each end of the pipe for about a foot was blown off, and into small fragments, leaving half of the remainder split open and flattened out as by a hammer, and the other end flaring and jagged.

DUALIN.

Another powerful explosive compound has recently been brought before the public and patented in the United States. It is known as *dualin*, and appears to be a mixture of nitro-glycerine and nitrogenized cellulose, made from sawdust. It was first introduced into Germany in April, 1869. In many mining districts, especially in mines belonging to the Prussian government, it is now used in the place of common powder, and has taken the place of nitro-glycerine and dynamite. (giant powder.)

Lieutenant Dittmar, the inventor, and the manufacturer of the article at Boston, describes dualin as a powder:

> It is fabricated in six different degrees of strength, the use of which will depend on the degree of hardness and toughness of the material intended to be subjected to the action of the powder. Dualin will, if lighted in the open air, burn without exploding; but, if confined, may be made to explode in the same way as common powder. It is not sensitive to concussion; will not decompose by itself, nor cake or pack together, and may be readily filled into cartridges or blast-holes, requiring no other than water-tamping. It matters not whether the place where it is stored be warm or cold, dry or damp. Dualin has from four to fifteen times the strength of common powder, and is, therefore, stronger than nitro-glycerine or dynamite. The advantages claimed for dualin over other explosive agents are—
>
> First. It may be stored, transported, manipulated, and applied with less risk than common powder.
>
> Second. It may be used in cold weather without first requiring the warming process, which nitro-glycerine and dynamite require, as they frequently become inexplosive at a low temperature.
>
> Third. Its explosion does not develop any noxious gases.
>
> Fourth. Absolutely cheaper than either nitro-glycerine or dynamite, dualin is also relatively cheaper than common powder, for, possessing four to fifteen times the strength of the latter, its use will proportionably reduce the labor and cost of mining and blasting operations.
>
> Fifth. The effect of a dualin explosion is to tear and rend the material exposed to its action, less than to pulverize it, as is the case with nitro-glycerine when applied to mining and blasting operations in coal and rock.
>
> Sixth. Dualin, when confined, does not necessitate the application of an exploder, but may be exploded by a blasting fuse, like common powder.
>
> Seventh. Its great want of sensitiveness to concussion, renders dualin a suitable material for the bursting charge of shells.
>
> Eighth. Dualin may be stored for long periods without losing any of its strength.
>
> Ninth. Dualin may for days be subjected to the action of water without losing any of

strength. Tin cartridges are, therefore, never required, not even for submarine sting or blasts where water-tamping is used; and in shipping dualin packed in per or thin wooden cartridges, ready for use, the only object is to save the consumer ne in charging his blast.

Directions for use.—Dualin is shipped in boxes containing the cartridges, all ready for e; the degree of the powder, the number of cartridges contained in each box, the ight, diameter and length of each cartridge being plainly marked on the box.

1. The common blasting fuse may be used whenever rock, sand, brick or clay is used r tamping. In this case the treatment of dualin is entirely analogous to that of mmon blasting powder.

2. Exploders are required for firing charges.

A. When no blast-hole having been drilled, the powder is simply placed on the surce of a boulder, &c., which it is intended to break.

B. When submarine blasts are to be made, or water is used for tamping, or the blast-les contain water.

C. When electricity is employed as a means of igniting the charge.

For heavy charges it will be well to use more than one exploder. The effect of the plosion depends greatly on the cartridge exactly fitting the blast-hole. Whenever dinary tamping is used it should be packed as compactly as common powder requires. ast-holes that will hold water require no other but water-tamping.

Mr. F. Shanly, the contractor upon the Hoosac Tunnel, has had some periments tried with dualin at the tunnel, and certifies that he has ed about 20 pounds, manufactured by Lieutenant Dittmar, and, so far an opinion could be formed upon so limited a quantity, he considered fully equal to nitro-glycerine in its results, while for safety in handg, it was proved by the most severe tests to be vastly superior.

In several of the blasts water-tamping was used. The charges were ed by means of electricity, using Mr. H. Julian Smith's battery. The me battery has been in service for some time past, in the operations the Hoosac Tunnel, and it is but just to state that in regard to the nsity of the spark developed, as well as to simplicity of construction d compactness, a more serviceable battery could hardly be recomended to the attention of all engaged in mining or blasting operations. his battery will be described in a future chapter. Another compound lled xyloïdine is manufactured at the same establishment.

The Journal of Applied Chemistry observes as follows in respect to e qualities and strength of dualin:

This compound, which, according to its inventor, Mr. Dittmar, possesses the explore power of nitro-glycerine, together with the slow combustibility of ordinary gunwder, consists principally of nitrate of ammonia and fine sawdust, that has been ted upon by nitro-sulphuric acid. This material, according to Fuchs, is undoubtly endowed with a greater explosive force than ordinary powder; it is also considd as being less dangerous in regard to spontaneous explosion. In its composition it similar to that of gun-cotton, being also subject to gradual decomposition in moist r. In regard to the efficacy of the dualin, as compared with dynamite, (which is a ixture of nitro-glycerine and infusorial sand,) the inventor states that they are both ual in this respect. However, it is extremely difficult to get at comparable results blasting experiments; in most instances, the experimenter must be satisfied with e average results of a great number of trials undertaken under various conditions. t it is nevertheless easy, in one respect, to fix a difference between the two mateals, which leaves no doubt as to the superiority of the dynamite. If equal quantities dynamite and dualin, provided with primers, are allowed to explode upon air ates of equal strength, the effect indicates such an evident difference that one must judge to the former a much more rapid and violent action. This will certainly be cognized in blasting rocks. In price dualin is cheaper than dynamite. When comg in contact with fire, it will certainly cause explosion, as it burns quite as rapidly ordinary powder. Of the dynamite, however, it is sufficiently established that it ll never explode on holding a flame near it, but simply burn quietly, even if inclosed strong wooden boxes. Against pressure and concussions, both blasting materials e equally inert, and, finally, dualin possesses the advantage over dynamite that it does t freeze, while the latter, when in a frozen state, cannot be directly exploded. But as sting is mostly suspended during frost, this circumstance is not of very great imrtance; moreover, the use of dynamite is not excluded at all, if frozen, as it will dily yield by the explosion of a small cartridge containing non-solidified dynamite. e great superiority of dynamite, above all, consists in its non-liability to become moist; this property allows its direct application under water and in bore-holes, while dualin, like gunpowder, does not bear contact with water.

The objection thus urged against dualin is contradicted by the inventor, who declares it to be insensitive to moisture.

PYROXYLINE, XYLOÏDINE, GUN COTTON.

The name pyroxyline is given to the very inflammable and detonating compound produced by the action of concentrated nitric acid upon cellulose, or substances such as cotton, linen, hemp, paper, and sawdust. The name xyloïdine was given by Braconnet, in 1833, to the white, pulverulent, and very explosive substance he had obtained by treating starch with many times its weight of concentrated nitric acid.

The preparation of gun cotton for mining purposes has been greatly improved. It is now made into pulp, and then compressed into solid cylinders, which burn harmlessly when ignited in the open air, but explode with intense violence when confined and ignited by a detonating compound.

In its old form, it was experimented with at the Gould & Curry mine, in Nevada, with apparently good results. A report of these experiments states that a 1¼-inch hole, twenty-eight inches deep, in hard and tightly-bound rock, charged with six inches of cotton and exploded, threw down as much rock as an ordinary charge of gunpowder, without producing any smoke.

OLIVER'S POWDER.

A new powder, under the above name, has been manufactured near Wilkesbarre, Pennsylvania, for some months past, by the Luzerne Powder Company, a corporation organized by some of the principal coal operators of that region. It is believed that the invention is calculated to be of great public benefit, by reducing the risk and danger in the manufacture of powder, and by producing, at the same time, a safe and powerful explosive. General Oliver's patents refer to both the ingredients used and to the machinery employed in the manufacture of the powder. In composition, the principal difference between this and other powders is the substitution of peat for charcoal; and this, together with the method of manufacture, produces an article which, it is claimed, has invariably shown, in the "powder prover," a strength from twenty t thirty per cent. greater than that of Dupont's, Hazard's, Smith & Rand's or any other powder now in use in the coal region. The sporting powder of the Luzerne Powder Company, as compared with the finest brands o rifle powder, is stated to give a much higher velocity, and consequentl a greater penetration to the ball; to foul the gun less; and, like th blasting powder, to produce less smoke than do the powders now in us The machinery used in the manufacture is very simple and inexpensi and only a very small quantity of powder is at any one time in the mil and that, while unconfined, is inexplosive. The success attending th manufacture by the Luzerne Powder Company has been sufficient t induce the company to determine on building a second mill near Hazl ton, Pennsylvania.

Another substitute for charcoal, which has been tried with favorabl results in the manufacture of gunpowder, is the mineral known as Gr hamite, and occurring in West Virginia. Its application for this pu pose has been patented by Dr. Van der Weyde, of New York.

CHLORATE OF POTASH POWDER.

called "safety explosive compound" has been patented in Eng- y Mr. Percy A. Blake, of Aberdeen Park. The constituents of npound are sulphur and chlorate of potash, in the ratio of one of ner to two of the latter. These substances are kept separately ŗ, and are mixed when required. The powder burns slowly when , but explodes under percussion. This explosion is effected by of a detonating tube of metal, about an inch long and $\frac{7}{32}$ of an diameter, partly filled with the compound and with fulminating ŗ, and lastly with powder. This powder may be ignited by any y ignition apparatus.

irst attempts to make powder with chlorate of potash, sulphur, bon, were those of Berthollet, in 1788. In 1792, experiments in ufacture were made at the works of Essonne under his direction; y were stopped by a terrible explosion which destroyed the lives director of the works, his daughter, and four workmen. Ber- who was with the director, had a wonderful escape. The ex- was caused by the end of the director's cane striking some of rder upon the floor.

s also been attempted to use various mixtures of the chlorate iite sugar and prussiate of potash and with charcoal and sul- of antimony and starch; but all these compounds are exceed- ingerous to manufacture or transport, and it does not appear e that they can ever come into general use.

iining purposes a mixture of tan-bark, chlorate of potash and has been made at Plymouth, England. The tan is soaked in a olution of the chlorate, and afterward covered with a film or powdered sulphur. This preparation is said to burn but slowly pen air, but when confined, as in the hole of a boring, it ex- vith great energy.

te of potash has also been experimented with, and used for tor- but its preparation has led to some frightful accidents; that at onne, in 1869, killing five persons and wounding many more.

EXPLODING CHARGES BY ELECTRICITY.

clin, in 1751, and Priestley, in 1761, suggested the possibility of g the electric spark for the ignition of gunpowder charges; but ty was not practically applied until about thirty years ago, by ich military engineers, since which its use has become general. mployed to ignite the great blasts that destroyed the Round Dover, and to remove the wreck of the Royal George; and has gely used in heavy blasting with powder and nitro-glycerine in ia and for exploding torpedoes under water.

ariety of contrivances is very great. Many exploders have been to act either by heating a piece of thin wire, introduced in the f a battery and placed in the charge, or by the passage of a oduced by an electro-magnetic machine or Ritchie coil through ve explosive compound, thus causing a local explosion sufficient the whole charge.

g those who have given great attention to this subject, Baron ner, of the Austrian military engineers, may be specially men- nd Mr. Abel, of the British war department, who has devised the best exploders known. A spark generated by revolving is made to pass through a mixture of subphosphide and subsulphide of copper and chlorate of potash—materials of high conducting power and extremely sensitive to the spark. One of the great difficulties in the way of making such exploders is the liability of the materials to be merely thrown aside and not exploded by the passage of the spark.

In the United States inventors have been active in devising different forms of apparatus for igniting explosives. They all depend upon either the direct passage of a spark or the heating up of an imperfect conductor, immersed in an explosive mixture. This mixture and the arrangement of wires are inclosed in a small cartridge of paper or wood, which can be readily placed in the midst of the powder in the hole to be exploded. Mr. Stowell patented, in 1862, a peculiar form of cartridge containing the ends of the conducting wires and a strip of platina. Beardslee, in 1863, patented a very simple mode of making an imperfect conductor between the ends of two wires, by drawing a pencil mark of graphite, upon the surface of a piece of dry wood. Mowbray, in July, 1869, patented an improved electrical fuse for exploding charges of nitro-glycerine. It consists of a small cartridge of powder, in the top of which is placed a small quantity of a composition, like that used by Mr. Abel, made of sulphide of copper, 9 parts; subphosphide of copper, 2 parts; chlorate of potash, 3 parts, the whole intimately mixed. The ends of the wires are immersed in this mixture. It is designed especially to be inserted in cans of nitro-glycerine, to be exploded in oil wells.

The dealers in the new explosive compounds, such as nitro-glycerine, dynamite, and dualin, furnish exploders especially designed for the several preparations. These various exploders may be fired either by the voltaic current or by a spark from a suitable electrical machine, or the Page coil. An electrical machine has recently been invented and patented by Mr. H. J. Smith. The following is a description and the claim: *

> The object of this invention is the production of an electrical machine constructed with especial reference to portability, and to working in all conditions of the atmosphere. It is designed more especially for igniting charges of powder by means of the electric spark which it evolves.
>
> It is well known that the electrical machine, as commonly constructed of glass, becomes wholly inefficient in a damp atmosphere, such as prevails in tunnels and mines. This is due to the fact that glass so very readily condenses moisture upon its surface, in the form of a continuous film. Vulcanite, on the contrary, does not so readily condense moisture. Nor does it condense moisture in the form of a film, but rather in the form of detached drops.
>
> The machine consists of an outer covering or shallow box, containing a frame plate, a Leyden jar or condenser, a generating plate of vulcanite, and devices for operating the generating plate and condenser in connection.
>
> The frame plate, the condenser, and the generating plate are placed parallel to each other, and parallel to the sides of a box about a foot in diameter.
>
> The condenser is connected to the frame plate by four posts, 1, 2, 3, and 4.
>
> The generating plate of vulcanite lies between the condenser and frame plate, and is revolved on its axis by means of a handle or crank.
>
> The axis of the generating plate passes tightly through a stuffing box, which may be made to grasp the axis more or less tightly, by means of a packing screw.
>
> The outer end of the axis has its bearing in a small hole sunk in the outer vulcanized plate of the condenser.
>
> The generating plate of vulcanite revolves between two cushions, the surfaces of which are coated with an amalgam, as is usual with electrical machines.
>
> The cushions are provided with flaps, which flaps serve to prevent the electricity from escaping from the generating plate until the excited portion of its surface arrives in the neighborhood of the collectors, which are serrated strips of metal, placed one on each side of the generating plate, and both collectors are attached to and in metallic

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* Vide letters patent, No. 93,563, August, 1869.

ection with the frame post 4, and by it are brought into connection with the r plate or surface of the Leyden jar or condenser.

e two outer plates or surfaces of the condenser are in metallic connection with the 2, and also with the cushions by means of post 3.

e inner plate connects with post 1, as well as with post 4.

e condenser is constructed in the following manner:

hen the vulcanite is in a plastic state, upon a layer of vulcanite is placed a layer n-foil. Over the layer of tin-foil there is placed a second layer of plastic vulcan- and then a second layer of tin-foil. A third layer of plastic vulcanite, a third of oil, and a fourth of vulcanite, complete the jar or condenser.

e first and third layers of tin-foil form the outer surfaces of the condenser, the mid- ayer forming the inner surface.

re must be taken that the diameter of the tin-foil plates be less than that of the rs of plastic rubber, excepting a small projection from each tin-foil plate, intended nnect with the posts of the frame. The condenser, thus made up, is then sub- ed to the baking or vulcanizing process, at the end of which it becomes hard and l. Its surfaces will forever remain in a perfectly dry condition.

e posts 1, 2, 3, and 4, are now screwed into the condenser, posts 1 and 4, as before d, connecting with the inner surface, while posts 2 and 3 connect with the outer ces.

the outer casing are attached two knobs. These knobs are electrodes, or paths he discharge of the electricity when they are brought into contact with the inner outer surfaces of the condenser, which is done by turning the handle of the ma- e backward a little, until the post 1 comes into contact with a projection from one , and the post 2 comes into contact with the projection from another knob.

ere is a stop, which serves to prevent the framework of the machine from revolv- by the action of the crank, except through a small arc. The post 1 is limited in its ard motion by the stop, and in its backward motion by the projection from the .

e casing is made of vulcanite. Two forms of casing are made: one, a box in halves, h are screwed together, with a packing of soft rubber or other air-tight material een them; the other, a box with a cover, having a rubber band placed over and nd the outer edge.

e operation of the machine is as follows:

turning the crank the generating plate is revolved between the cushions. The tricity generated is collected by the collectors, and from them carried by post 4 to inner surface of the condenser. The opposite electricity appearing at the rubbers, nducted from them by post 3 to the outer surface of the condenser.

continued turning of the crank, the condenser may be charged sufficiently to a spark of three-eighths or one-half an inch in small machines of five or six inches iameter.

e first motion of the crank turns the frame, as well as the generating plate, until 1 strikes the stop. Turning the crank backward brings posts 1 and 2 in contact the knobs, when the condenser may be discharged. It is desirable that the con- er be discharged by the posts 1 and 2, rather than by posts 3 and 4, which are used harging, as the tendency to escape during accumulation is thereby avoided.

e frame plate and the generating plate are both made of plastic rubber, and vul- zed.

e capacity of a Leyden jar or condenser constructed of plastic rubber and metallic es, as above directed, may be increased by adding successive layers of metal and anite. Such a condenser will be of use for electrical purposes independently of generating apparatus herein described.

e inventor claims:

A generating plate and a flat condenser, placed parallel to each other within the casing, substantially as described.

A Leyden jar or condenser constructed of vulcanized rubber and metallic plates, tantially as described.

So arranging the jar or condenser that the forward motion of the crank, to gen- electricity and charge the jar, moves the jar forward through a small arc, whereby erminals are moved away from the discharging knobs.

The device for discharging the jar by the retrograde motion of the crank bring- he posts 1 and 2 into contact with the projections from knobs V and W.

Placing the firing points of the condenser at a distance from the collecting points, tantially as described.

The stop X, limiting the forward movement of the jar, substantially as described.

The combination of a generating plate, a condenser, and a casing, made air-tight, scribed, by packing or a rubber band, together with knobs in the casing, and projections, by which the condenser is discharged, substantially as described.

ECTION II.—BORING AND EXCAVATING BY MACHINERY.

CHAPTER LXVII.

MACHINES FOR DRILLING ROCKS.

hines for rock-drilling originated in the United States, where one ut into practical operation as early as 1838. The attention of nicians and inventors being thus early directed to this great desid- n, a machine that could be economically and easily substituted for labor, so great a variety of contrivances and forms have been pro- and experimented with, that their number renders it difficult even merate them. Our Patent Office and the patent offices of Europe n many models of machines; but most of them are of the class as "drop drills," where the tool cuts by percussion. There are forms of machines, fitted with revolving disks or cutters, and ed to bore out the drift or tunnel to its full size at one operation; thers, again, in which a number of drills are mounted in a frame, to cut an annular space around a central core of rock, which can ard be broken out with powder or otherwise. There is still another in which diamonds are made to do the cutting by pressure and on, without percussion. Rock-drilling machines may therefore be ed in two great classes: 1. Those that bore by percussion; ose that bore by constant pressure and rotation.

drop drills belong to the first class, and will be first considered. ese machines the drill or bar of iron or steel—either a single rod vided with a steel bit or point at the lower end—is raised by means rank, cam, or other mechanism, and then allowed to fall by its eight upon the rock to be bored. There are also numerous con- ces to accelerate the speed of the fall and increase the force of the Metallic and rubber springs have been used, and, in some cases, the city of air; but in all these modifications but little has been gained the form in which gravity acts unaided. With springs, the greatest ression and force is exerted when the drill is at its highest or st from its striking point, and as the drill descends this force nes less and less—the reverse of the most desirable condition given avity.

s desirable to note a few of the more important of these inventions have been in use practically during the past thirty years, and , by successive modifications and improvements, have led to the nt very considerable degree of perfection of rock-drilling machines.

early as 1838, Messrs. J. M. and John N. Singer experimented with ge drop drill on section 64 of the Illinois and Michigan Canal, thirty miles below Chicago. This machine was patented in May, and some ten or twelve machines were built for, and used upon, anal until the suspension of that work in 1841–'42. They were used in the Mount Washington cut, near Hinsdale, for the Western ad of Massachusetts. Two machines were built at Lockport, in and used upon the enlargement of the Erie Canal. Modifications of these machines are even now in use in various parts of the country. They are all drop drills, and their operation is restricted to vertical holes.

The original Singer drill, as applied in Illinois, is considered to have been the first successful machine for its purpose. It was extensively copied, and many improvements upon it were claimed from time to time. The first substantial departure from it was made by J. J. Couch, aided by Joseph W. Fowle, of Boston, in the year 1848. They constructed a steam drilling machine, in which the drill-bar passed directly through the piston of the engine and was alternately caught, drawn back, and thrown against the rock. It was only used a short time in experimenting, and was finally taken apart and sold at auction. Although not a success, this machine marks the second phase of the rock-drilling machines, and was the first attempt that approached success in the direct application of steam-power to rock-drilling.

From the time of this experience the two inventors separated, Mr. Couch following up the general idea of a hollow-piston drill, while Mr. Fowle, discarding the idea of the hollow piston, conceived that success would be gained by placing the drill directly upon the end of a solid piston-rod. During a period of five years Mr. Couch produced a number of drilling engines, variously constructed, but all upon the hollow-piston plan. Some of these were in a measure successful, but not sufficiently so to insure their general adoption. They required very nice adjustment and presented practical difficulties; and finally this style of machines was abandoned.

Mr. Fowle, adhering to his plan of attaching the drill directly to the piston-rod or cross-head of an engine, experimented and struggled against many obstacles for several years. He built, in all, some five machines, but did not succeed in carrying his plan to perfection, until, discouraged and disabled by sickness, he suspended his efforts.

In the year 1861 machine drilling was experimentally begun by Sommeiller, at Mont Cenis, with machines virtually upon the principle of Fowle's, though different in construction. To M. Sommeiller belongs the credit of driving such machines with compressed air, a very important application of this power for all tunnel or mining work, especially where artificial ventilation is required.

The magnitude of the undertaking to tunnel the Hoosac Mountain, in Massachusetts, upon the line of the Troy and Greenfield railroad, prompted the commissioners having it in charge to seek all means of accelerating the work, and their attention was naturally directed to the reports of rapid progress by machine drills at Mont Cenis. The report being favorable as to the results, while the machine of Sommeiller was not regarded as specially adapted to the work on the Hoosac Tunnel, it was decided to devise and perfect a drill for the purpose. As a first step, Couch's patent of the hollow piston-rod was purchased for New England, and scientific mechanics were employed to work upon it. One of these machines, constructed by Mr. Hanson, is known as the

HANSON MACHINE DRILL,

which promised some success, but on trial proved a failure. It had a cylinder and valve-motion, similar to those of a steam-engine. The piston was hollow, with the drill-bar, of any required length, passing through it and moved by the piston, by means of four wedges or cams at each end. These cams were pressed upon the drill-bar by means of sliding collars, forced upon them by a complex arrangement of mechansm, acting alternately upon one and the other, for the purpose of atching and throwing the drill-bar. The rotation of the bar was ffected by means of a ratchet, worked by a spiral groove in the shield f the machine. There were 120 pieces in this machine, and it weighed 00 pounds. It did not work well horizontally. The main difficulty was with the cams and collars for seizing the drill-bar.

A second machine, called the

BROOKS, BURLEIGH, AND GATES MACHINE,

made under the direction of the commissioners at Fitchburg, was put upon the works and used for several months. This machine also had a hollow piston, the drill-bar or holder being a screw, passing through the piston and moving with it. The feed was given by means of a nut on the end of the piston-rod, held by means of a cap or union nut, the latter being screwed on to the coupling, and the coupling-nut screwed to the piston-rod. The feed nut turns in the union nut, and protrudes from it. A ratchet, moving with the piston, works upon this feed nut, and is governed in its action upon the nut by a spiral groove in a shield attached by screws to the cylinder. On the ratchet band there is a pawl, with two springs, one under the other; one serves to hold the pawl in gear, the other to hold it out of gear. As the piston descends, the outer spring comes in contact with a trip on the shield, and is lifted up, allowing the under spring to throw the pawl into the ratchet; and as the piston returns, the outer spring turns the nut round, and thus feeds the screw, or the drill-bar, forward. At the end of the back stroke, the pawl strikes another trip on the shield and is thrown out of gear, and is held so by the outer spring, made with a catch. The rotary motion of the drill-bar is given by a ratchet on the coupling-nut, covered by a ratchet band, the arm of which moves in a spiral groove in the shield, similar to the other. The crosshead is held between two check-nuts, on the coupling-nut. It carries a bar, governing a valve which opens the port when the piston and drill-bar move back, and shuts it when they move forward; the air is always pressing during the backward stroke. The area of the back of the piston being greater than the front, the forward pressure preponderates and carries the piston forward, and when cut off the backward pressure returns the piston.

The piston-head of this machine has a diameter of $4\frac{5}{8}$ inches and the diameter of the piston-rod is 4 inches at the large end and $2\frac{1}{4}$ at the small end. There are, therefore, 12.87 square inches of area on the back, upon which the compressed air acts to drive the drill forward against the rock, and 4.23 inches area on the forward end upon which the air acts to throw the drill back out of the hole. As the pressure was not removed from the front of the piston the motion forward was due to the difference of area between the back and front of the piston, viz: $12.87 - 4.23 = 8.64$ square inches.

This machine was automatic, and it generally continued to work until some part gave way. No part of it was found to be strong enough to withstand the shocks for any considerable portion of time. The union nut was its weakest point; and the breaking of this nut generally destroyed the part of the piston to which it was attached. The springs of the feed ratchet-band were also almost continually breaking.

This machine had 80 pieces; of these 23 were screws, 15 pins, and 7 pieces of cast iron. It weighed 240 pounds, made about 200 strokes per minute, and cost about $400. Its longest run, without breaking, was five days. To run for two days without breaking some part of the machine was considered fortunate. More than one breakage a day was the average.

The experience with these machines at the Hoosac tunnel was discouraging. About forty machines were used there, and of these eight or ten were originally vertical, and intended for use in sinking the central shaft. Owing to the many breakages it was difficult to keep up a supply, and the progress of the work diminished in proportion to the giving out machines. It was the opinion of the engineer that if a constant supply of machines could have been furnished the progress would have been much greater than that attainable by hand labor. The average "life" of one of these machines was about eighty hours, and it is said by those familiar with the operations at the tunnel at that time, that soon after starting them at work the tunnel seemed to be a highway, along which a crowd of people was continually passing, each person carrying a portion of a drilling machine, or tools and materials for repairs.

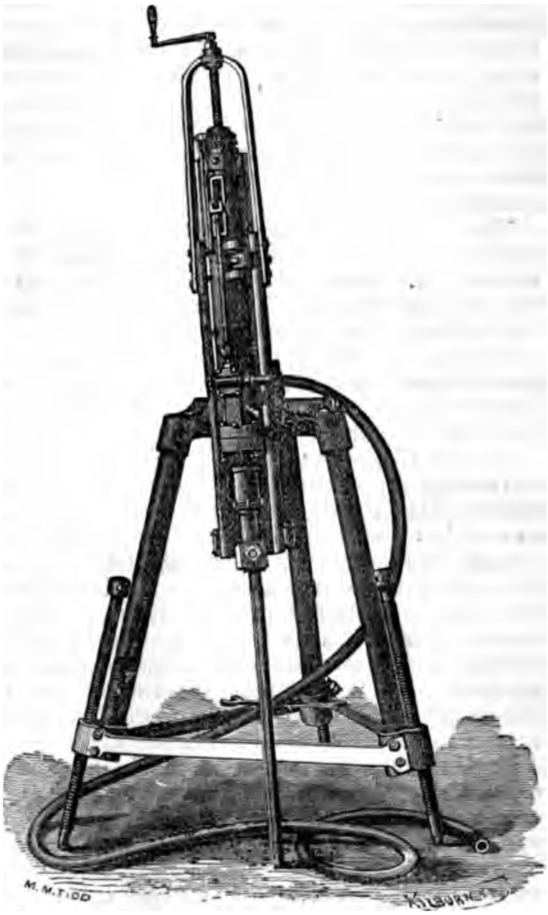
This unsatisfactory experience led to the gradual abandonment of the Brooks, Burleigh, and Gates machine, and the substitution for it of a new and simpler machine, made by Mr. Charles Burleigh.

THE BURLEIGH ROCK DRILL.

Abandoning the idea of constructing a machine upon the Couch or hollow piston principle, Mr. Burleigh purchased the Fowle patent, and commenced the construction of machines with solid pistons, arranging the details of construction so that the parts should be few in number, and strong enough to bear the great shocks of working. In this he claims to have been successful; and it is stated that sixteen out of the twenty machines furnished for use at the east end of the tunnel were still in operation at the close of the summer of 1869, some of them having been in use since November, 1866.

According to a report made by a joint committee of the Massachusetts legislature, the construction of this drilling machine, in 1867, was substantially as follows: It has a solid (so-called) cast-steel piston, to one end of which the drill or bit is attached, while the other end within the cylinder, by means of suitable mechanism, operates the valves. The piston-head has a diameter of 4.25 inches; the piston at the large end 3 inches, and at the small end, 2.75 inches. The number of inches of air area is thus 8.20 when the drill is thrown out upon the rock, and 7.07 when returning. On the back end of the piston is a section of a ball used as a cam, which works the valve and the feed motion. The movement of the piston brings the ball into contact with these cams, and, by rocking them back and forth, opens and closes the valve. The cylinder is supported upon parallel ways or a bed-plate, upon which it slides up and down as moved by the feed-screw. This feed-screw passes through a gallows frame, attached to the upper end of the ways, and the lower end of the screw, passing through a feed-nut, enters the cylinder. The end of the piston is drilled out, so that the feed-screw is not struck during the oscillations. The feed-nut is secured between two collars, so that it turns easily, and its outer edge is cut into a ratchet, into which works a pawl, operated by the piston, turning the nut upon the fixed feed-screw, and moving the cylinder, drill, &c., forward. This machine weighed 372 pounds, including the ways or bed-piece; without the ways the weight was 212 pounds. It comprised eighty pieces, and had the same number of screws and pins as the Gates, Brooks, and Burleigh machine. Its number of strokes was 300 a minute. They the work much better than the former machines, and their aver- life" in the tunnel without repairs was about five days. One d for fourteen days without repairs.

external appear- of the Burleigh g-machine as now is shown by the . It is simpler and ;er than the ma- of 1866. It has 27 less than that ma- Five sizes are drilling from ¾- o 5½-inch holes, and g from thirty to eighty-four without change of oints. The piston- o which the drill- is directly at- l, is made of solid teel. The machine constructed that ston-bar is the only of the machine receives the shock ing from the blow the rock. With a ire of 50 pounds to uare inch, the drill s from 250 to 300 per minute. It s from 150 to 1,000 ls, according to nd can be operated by steam or by essed air. The size mended for gen- aining is the tun- ze, weighing about


Burleigh Drilling-machine.

ounds, drilling 1¼ to 2¼-inch holes, and feeding 36 inches without e of drill-points. It will drill from 2 to 6 inches a minute, accord- the hardness of the rock.

ides being in operation at the Hoosac Tunnel, these machines are e been in successful working operation in New York, Chicago, City, Hell Gate, Scranton, Lake Superior, Colorado, Nova Scotia, Pacific railroad, Boston and Hartford railroad, &c., and in ning the beds of the Illinois and Michigan Canals at the Des s Rapids.

Colorado, Mr. Burleigh is running a tunnel to intersect several at a considerable depth. It is found advantageous to make this l larger than is usual, in order to have room for the machines and acks. It is, therefore, cut eight feet high and nine feet wide. A track is laid with iron rails as the work advances. Two inside of men, four in each, are worked regularly; and with the drilling nes the progress in a hard crystalline rock has been, of late, as great as 60 feet per month. In one week, 15 feet of advance was made, and at a cost per foot of $37 50, including all expenses. The tunnel has now penetrated 415 feet in the solid rock, and the average rate of progress for some months before the machines were carried to their present degree of perfection was 40 feet per month, which was at least four times as great as could be accomplished by hand labor. The expenses of running a tunnel in Colorado, near Georgetown, are much greater than at the East. Miners' wages are $4 per day; blacksmiths', $6; powder, $8 per keg; wood from $5 to $6 per cord, and all supplies are costly. The cost of driving the tunnel up to March, 1870, had been $62 per running foot; which is much less than it would have cost by hand labor alone.

The Baltimore Tunnel, in the vicinity, is being driven with three shifts, of three men in each, at a rate of 50 feet per month. Another tunnel, worked by hand labor alone, is advancing only 8 feet per month. Mr. Burleigh thinks that he can drive the large sized tunnel more rapidly and cheaply than one of the ordinary dimensions.

At Hallett's Point, near New York, these drills have been advantageously used; and it is believed that they accomplish from three to four times as much as can be done by hand for the same cost, and in much less time.

At the Hoosac Tunnel, (January, 1870,) the Burleigh drills are used in driving the "headings" only at both ends of the tunnel—nine machines at the eastern end and eight at the western end. The heading or advanced opening is 8 feet high and 24 feet in width; and in the eastern end is made on the floor, and in the western end, next the roof. The enlargement is at present carried forward entirely by manual labor; but arrangements are making for the use of the machine drills for the enlargement of the eastern end. The rock is a compact mica slate, in which, at the western end, veins of quartz, sometimes many feet in thickness, are of frequent occurrence. In the eastern end, however, the mica slate is comparatively free from these veins or bands, and the rate of progress there is much greater.

In the western end eight drills are kept constantly at work. Four drills are mounted upon a carriage, which, with its load of drills, tools, &c., weighs, by estimate, about five tons. There are two carriages, which are brought into position upon parallel railways, laid as the work progresses. The holes are commenced with 2-inch drills, and finished with 1¼-inch drills, or drills which cut holes of those diameters. The average depth of the holes is about 50 inches. At the western end, where the quartz veins are so frequent and hard, the working of the drills is so constantly interrupted by stoppages that it would require very extended observation of one machine to determine the work it is capable of performing. One of the machines, in the presence of my brother, drilled about twelve inches in ten minutes, making, as nearly as he could estimate, something over 200 strokes per minute. The rock consisted largely of quartz. In boring a hole 5 feet in depth in such rock, the drills are often changed as many as ten times. According to Mr. Roscoe, manager of the western end of the tunnel, one of the new drills had drilled a hole 5 feet in depth in quartz rock, such as frequently occurs there, in 25 minutes. At the eastern end, where the rock is mica slate without the heavy quartz veins, a hole of equal depth is often drilled in from 10 to 12 minutes. According to Mr. Shanley, from 800 to 900 inches are drilled in the western heading during every shift of eight hours; and the daily progress of the tunnel is about 4 feet. In the eastern end, however, with nine drills, from 1,600 to 1,800 nches are drilled every shift, and the daily rate of progress is about 6 eet. Blasting is done twice in every shift.

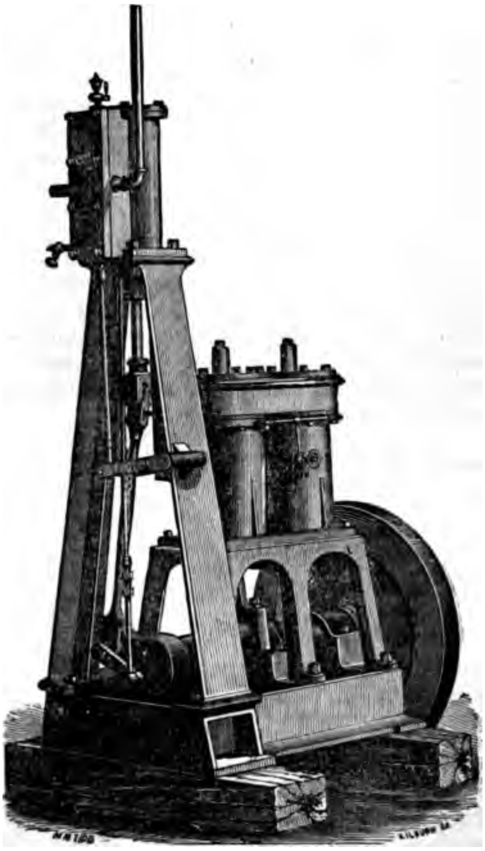
It is the opinion of the superintendent that in the eastern end the ost of drilling by the Burleigh drill is to the cost of drilling by hand, s 4½ to 7. In the western end, however, it is believed that the machine drilling, owing to the numerous stoppages, is as expensive as it would be by hand.

Each drill requires the constant attendance of two men. In hard ock it is found necessary to feed the drill by hand instead of employing he automatic arrangement provided for that purpose. Hence, at the western end, where the rock is so highly quartzose, the feeding is done entirely by hand; but in the eastern end, where the rock is less hard and of more uniform character, the feed is automatic.

At both ends the wear and tear on the machine drills is necessarily great; but in the western end particularly so—so great, in fact, that on an average two drills are in the shop for repairs to one at work in the 'heading." But this end had not been fully supplied with the *new* Burleigh drills.

As before stated, these drills may be operated by either compressed air or by steam. For all underground operations the former is used. At the western end of the Hoosac Tunnel four of Burleigh's air-compressers are used for the compression of air to work the drills. The compression is rapidly effected by pumps, worked by a team engine.

The reservoir at that place consists of two cylindrical vessels of boiler iron, 25 feet long and 5 feet in diameter, in which he compression is carried to rom 50 to 60 pounds to the nch, or three and one-third to our atmospheres. The air is conveyed in iron pipes 8 inches n interior diameter.



Burleigh Air-compressor.

COMPRESSED AIR AS A MOTOR IN MINING.

The annexed figure shows he form of the new machines used by the Burleigh Drill Company for compressing the air by which the drills are worked in the end of a tunnel, r for other purposes where compressed air can be used to advantage.

It is obvious that for underground operations, in deep shafts, and in tunnels, steam annot be used as a motor. Aside from the difficulty of conveying it great distances in pipes without great loss by condensation, its discharge in the confined galleries of a mine would render working impossible. Compressed air, on the other hand, when conveyed from the exterior to the interior of a mine, and discharged there, gives a constant supply of fresh, pure air, promoting the health and comfort of the miners.

The compressors now used with great success, consist of a steam-engine connecting by means of a crank shaft with two single air pumps, arranged as seen in the figure. It is very compactly and strongly built, and, by a nice adjustment of the cranks, the greatest power of the engine is applied at the point of greatest resistance. These compressors are made of three sizes, rated as Nos. 1, 2, and 3, and with the following dimensions:

Dimensions of air compressors.

	Number One.	Number Two.	Number Three.
Steam cylinder	6¼-inch diameter 15-inch stroke	9-inch diameter 18-inch stroke	10¼-inch diameter. 18-inch stroke.
Air cylinders, each	10¼-inch diameter 10-inch stroke	12-inch diameter 15-inch stroke	14¾-inch diameter. 15-inch stroke.
Size of base	45 × 35 inches	45 × 56¼ inches	48 × 64¼ inches.
Extreme height	7 feet 5¼ inches	9 feet 3¼ inches	9 feet 3¼ inches.
Weight	3,800 pounds	7,600 pounds	11,000 pounds.
Cubic feet of free air compressed per minute at 90 revolutions	90.19 cubic feet	176.70 cubic feet	266.97 cubic feet.
Size of discharge pipe	2 inches	2¼ inches	3 inches.

The air, when compressed, is taken into a tank, or air-chamber, and thence carried to any desired point in pipes, in the same manner that steam is carried. Connection between the permanent pipes and the rock drills upon the carriages is made by flexible rubber pipe, which is uncoupled when the carriage is run back for a blast.

The constructors of these compressors claim that, with eighty pounds of steam, they have compressed air to an equal degree, so as to produce an equilibrium between the condensed air in the receiver and the steam in the boiler.

In regard to the economy of transmission of power to a distance by means of compressed air, the practical results at the Hoosac Tunnel are extremely favorable, and show, as already mentioned, but a slight difference of pressure—about two pounds—between the two extremes of a pipe 7,150 feet long and eight inches in diameter. The following table shows the result of some experiments made while from five to nine drills were in operation:

Results of experiments upon the loss of pressure by the flow of air in an 8-inch pipe.

Time.	No. of compressors running.	Revolutions per minute, No. 1.	Revolutions per minute, No. 2.	No. of drills running.	Pressure per inch at compressors.	Pressure per inch at heading.	Difference in pressure.
					Pounds.	*Pounds.*	*Pounds.*
1 p. m	2	76	80	6	67	65	2
1.10 p. m	2	90	92	9	63	62	1
1.20 p. m	2	104	96	7	64	62	2
1.30 p. m	2	112	104	6	65	62	3
1.40 p. m	2	90	96	7	67	64½	2½
1.50 p. m	2	96	96	5	66	63½	2½
2 p. m	1	....	94	4	67	64	3
2.10 p. m	2	88	92	6	66	64	2
2.20 p. m	2	86	92	6	67	66	1
2.30 p. m	2	90	90	8	66	65	1
2.40 p. m	2	88	88	5	67	65	2
2.50 p. m	2	92	90	6	65	64	1
3 p. m	2	92	90	6	65	63	2

Average loss of pressure, 2 pounds. Average number of drills running, 6. Length of 8-inch air-pipe from compressors to heading, 7,150 feet.

These results are in accord with those obtained by the engineers at It. Cenis, where, at the date of the report of progress of the work in he year 1863, the air was conveyed a distance of nearly 2,000 metres, nd worked nine drilling machines with a force of two and a half horse-ower each. The tube, like that at the Hoosac, was nearly eight inches n diameter. The air was compressed to six atmospheres, and its velocity in the tube was about three feet per second. The transmission under hese conditions was not attended by any sensible loss, and the pressure was the same when the drills were all in operation as when they were at rest.

A series of experiments were made at Coscia by order of the Italian government in 1857, upon the resistance of tubes to the flow of air hrough them, and the following conclusions were deduced:

1. The resistance is directly as the length of the tube.
2. It is directly as the square of the velocity of the flow.
3. It is inversely as the diameter of the tube.

The whole subject of the transmission of power by compressed air is most thoroughly and ably discussed by Professor F. A. P. Barnard, in his report upon the Paris Exposition* of 1867, to which reference is made for further details upon this most important subject.

The compression of the air at the eastern end of the Hoosac Tunnel is ffected by water-power. Four 24-horse turbines operate 16 air-pumps, each of 13½-inch bore and 20-inch stroke; but these are not all used together.

The use of the machine drill in sinking the central shaft, now down over 800 feet, has been discontinued.

Directions for running the Burleigh drills.—Before attempting to start a drill the parts hould be thoroughly oiled by introducing oil through the plug marked "oil," and also behind the "feed lever," beneath the "momentum piece," between rotating ratchet and friction ring, and between rotating ratchet and inside sleeve.

In setting the drill carriage preparatory to drilling, the rear part of the same should e raised three to four inches above a level by turning down the back jack-screws. The machine is now ready to receive the drill point. This is done as follows: Raise he piston sufficiently to admit of the drill point entering the chuck. In doing this be careful to observe that the "momentum piece" is knocked back so as to clear the ball n the end of piston which moves the "momentum piece" and valve. Now let the piston drop down on the drill point and firmly secure the same by tightening the bolts n the chuck. Now feed down the cylinder by the crank on feed-screw, until the drill point touches the rock, and then feed it down three-quarters of an inch more if a "Tunnel pattern," or one inch if a "New York pattern," so that the piston will not strike he lower cylinder head when the drill is at work.

The drill is now ready for work. Let on steam, and if it does not at once start, knock he "momentum piece" (with a mallet or stick of wood at the knob upon the same) orward and back. If the piston raises and strikes one blow and stops, the valve gland must be tightened a little to prevent the valve from falling back over the port and cutting off the steam. Now strike the "momentum piece" as before, and the drill will start, unless the valve gland has been tightened so much as to prevent the full hrow of the valve. (Experience will guide in this matter.) Again, if the cylinder is ed down *more* than three-quarters of an inch, as above described, it will not start, in which case turn back the feed-screw a little.

Having once started, if the drill rotates more than one tooth at a time, the lower "stuffer" should be screwed up sufficiently to increase the friction on the piston rod to reduce the rotation. In case the drill will not rotate, screw up the set-screw in the friction pad, which will cause rotation. Observe that the spring over the rotating pawl is of sufficient strength to cause the pawl to throw into the notch, as the drill rotates. The same care should be used with the spring over "qualifier," for if too weak, or from any cause broken, the drill will feed itself down, cutting off the stroke, and in consequence stop.

By carefully following the above directions, the successful working of the drill is secured. Great care should be taken to prevent the piston from striking the lower cylinder head. This occurs if for any cause it does not feed fast enough, which will be the case if the spring over feed lever is not of sufficient strength, or a soft place in the rock is reached, or if the drill strikes through into a seam or cavity. This will be immediately detected by the difference in sound of the blows, and when it occurs the steam should be at once shut off, or the drill rapidly fed down by the crank on end of feed-screw.

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* Machinery and Processes of the Industrial Arts, &c., pp. 137–150.

To change drill points.—Having drilled the length of the first drill point, if a greater depth is desired, the drill points will be changed by following these directions: Loosen the bolts in the chuck, allowing the drill point to drop out. Bring the frame or carriage to a level by turning the back jack-screws, which will allow the passage of the longer drill down past the cylinder; raise the piston as before described, until the drill enters the chuck—then raise the rear of carriage to its former position—secure the drill and proceed as before.

Sharpening the drill points.—In sharpening the drills, care should be taken to form the points in the shape of a letter X, and not square like a +. On the two-inch (tunnel or mining bit) there should be a difference of at least $\frac{1}{8}$ inch between the lips of same. On the three-inch or New York pattern there should be $\frac{1}{4}$ inch.

If these directions are not followed the hole will be five-sided and cause the drill to bind.

In drilling, water should be occasionally fed into the hole to keep the point cool and wash out the debris. In case the drill binds from running off or any cause, the bolts in the clamp which holds the drill should be loosened to relieve the same.

The above directions for running a drill apply more particularly to vertical drilling, but are generally applicable to various kinds of drilling.

To take the machine apart.—Take out the bolts in the lower cylinder head; all the set-screws on the side of cylinder, feed-lever, momentum piece, rotating pawl, and friction pad; then pull the piston down with a jerk and it will start the inside sleeve. By continuing this operation the inside works can be removed. In putting the drill together, when the inside works are put in observe that the upper end of inside sleeve is flush with the lower end of rotating pawl, and that the back ring is opposite to the back set-screw. Turn the set-screws down firmly and replace the other parts as before.

SOMMEILLER'S ROCK-DRILLING MACHINES.

The following notice of rock-drilling by machinery at Mont Cenis is compiled from the report by Messrs. Geyler and d'Aligny. It is generally known that these machines are worked by compressed air:

On the Italian side of the Alps, at Bardonnèche, (the Piedmont entrance,) the air compressors are a kind of hydraulic ram, the valves of which are arranged in such a way that, at each lift of the valve admitting water, a certain quantity of air, at a pressure of five atmospheres, is forced into a reservoir 10 metres long and 17 cubic metres capacity.

The air compressors at Modane (north side) are composed of a horizontal cylinder full of water, in which a piston works, and of two vertical cylinders receiving the air, and provided with valves in their upper part. By the motion of the piston a quantity of air, equal to that of water displaced by the movement, is introduced and expelled at each stroke. The air is conducted to the boring machine by cast-iron pipes of $0^{m}.20$. It has been ascertained that the loss due to friction is about one-tenth of an atmosphere.

The boring machines of Mr. Sommeiller are essentially composed of a cylinder in which the compressed air works. The piston rod traverses the heads of this cylinder, and carries on one side a screw which commands the distributer. A machine similar to a steam-engine commands the slide valve of this distributer. This arrangement was adopted inasmuch as the stroke of the piston woich carries the drill varies with the hardness of the rock and the position of the drill in the hole, and no reliance could be placed upon the introduction of the compressed air by means of the percussion alone.

The whole apparatus weighs 200 kilogrammes. It rests upon a frame open in the center; the sides are $0^{m}.03$ wide by $0^{m}.05$ high, and $0^{m}.09$ apart; their length is $2^{m}.70$. They are cut upon their inside faces with screw thread, in which a screw moves, and the edge of their lower aces is cut with rack teeth, in which a pawl works.

The cylinder of the distributing machine is 0m.06 in diameter. The roke of the piston is 0m.10. It is furnished with a connecting rod and crank, and by means of gearing gives a rotary movement to a square em, upon which is fixed, first, a pawl, which advances tooth by tooth ratchet wheel provided with sixteen teeth, and fixed invariably on the rolongation of the piston rod in such manner that, after sixteen blows f the drill, the ratchet, the piston, and the drill have made a complete volution; second, a plate furnished with a cam which moves the slide d, and if we suppose that the slide valve, pushed by this cam, advances and stops the aperture for admission, the air which acts escapes rough the opening which communicates with the atmosphere by the ollow passage in the slide valve, and the piston is carried to its original position by the constant pressure which is exerted on its front face. t this instance the valve, abandoned by the cam, is pushed back suddenly to its initial position, by the difference of pressure which is exerted pon the two faces, and thus opens the inlet port.

The diameter of the piston of the boring machine is 0m.06; its stroke, 0m.20; and it gives 200 blows per minute. This machine is single-acting. The compressed air enters by the opening in constant communication by the conduit with the front part of the cylinder; when the piston is at the end of the stroke, the slide opens the inlet port, and the piston only advances in consequence of the difference of the pressure of air on its back face fitted with a slender rod, and on its internal face, of which the area is reduced by the large shaft of the tool-carrier. The impulsive force upon the piston is, for some of these machines. 5 kilogrammes, and for others, 150 kilogrammes.

We have before explained how the drill is made to rotate. It remains to show how it is made to advance, and how it can be rapidly taken out in case of need. If the screw, constantly geared into its nut formed by the internal filleted faces of the beds, were fixed permanently upon the shaft, it would follow that in each rotation of the drill it would advance the cylinder by a length equal to the pitch of the thread; but it should, on the contrary, only advance at the same speed that the drill enters the rock; therefore the screw works loosely upon the shaft, and only turns when a clutch box catches it, this clutch being continually pushed by the action of a spiral spring, which is retained by a rod connected with the clutch, and carrying at its front extremity—

1. A fork, the teeth of which rest against those of the rack on the lower part of the bed plate.

2. A prolongation terminated by a semicircular appendage.

If we now suppose that the piston is reaching the end of its stroke, with the drill scarcely touching the bottom of the hole, a tappet fixed upon the shaft of the tool-carrier strikes the above-mentioned appendage, forces it to drop, and detaches the tooth from the rack. Then the clutch box, impelled by the spring, catches and turns the screw, and the striking cylinder advances till the fork is caught by the following tooth of the rack, and thus disengages the clutch.

It may be conceded that Mr. Sommeiller has constructed an ingenious machine which fulfills the following conditions:

1. It strikes hard and rapid blows upon the rock.

2. It transmits a self-acting rotary motion to the drill, required to prevent it from becoming fixed in the hole.

3. It imparts also a progressive, self-acting, and regular advance to the drill as the hole deepens in working.

4. And lastly, it can be rapidly drawn back to change the tools.

The tool i a drill, with the cutting-edge in the form of a Z. It m a hole of 0^{S}.09 and 0^{m}.04 in diameter; but in the first case it i nished for 0^{m}.20 behind its head, with a bulge which trims or ream holes to full size. The stroke of the machine is but 0^{m}.80, but i make a hole to a depth of 0^{m}.90, by reason of the length of the d which vary from 0^{m}.50 to 2^{m}.

The apparatus placed before the breast of the gallery to be atta carries 8 drills, which cover a section 4 metres wide by 3 metres l equal to an area of 12 square metres. Eighty holes are bored, 6 of (and 74 of 0^{m}.04 diameter, and 0^{m}.90 deep. The daily work has v evidently according to the hardness of the rock. In March, 18 was 1^{m}.10 in twenty-four hours; in April, 1^{m}.40, and in some parts o strata even 2^{m}.50; but when the bank of quartz was met, which wa metres thick, the advance was hardly 0^{m}.50 per day.

During the month of March, 1863, it was shown that each explo of 0^{m}.70 to 0^{m}.80 required six hours for boring the holes, and four h for the miners carrying away the rubbish.

The staff employed for the boring of the holes during twenty-four h was as follows:

Two shifts..
Miners..
Laborers for taking away the débris...............................
Superintendents...

Total...
The compressors required..

Total...

In 1863 for 8 machines working there were 60 in the shop. In 1 when the work was carried on both from the French and Italian s the number of machines working was 16, and of those in the shop repairs 200.

In 1863, for repairing 8 perforators working in a coarse sandstone, (*à gros grains*,) the staff attached to the workshops consisted of 24 m

In 1867 the number was much greater, but exact information c not be obtained. The work had, however, been offered to a comp at 6,000 francs per running metre, the company taking all the appar and agreeing to repair the tools and clear away the débris. This refused, although the price was equal to 500 francs per cubic me The enormous shocks which the machine was subjected to obliged t to change the iron beds for Krupp steel ones; the springs often br and the drills did not advance 0^{m}.20 or 0^{m}.30 without requiring rep

DÖRING'S DRILLING MACHINE.

Mr. Döring, of Ruhrort, in Westphalia, has constructed a drill machine that has been used to great advantage in the zinc mines of Vieille Montagne Company at Moresnet, near Aix-la-Chapelle. The rector of these mines stated in 1867 that 11 of these machines, tw them of a recent construction, had been in actual use there, and t in one of the levels, where the rock was a very hard quartzose dolom they had made an advance of 3 metres in 14 days, where by hand driv 1½ metres only could be achieved. Sometimes the machine could adva [illegible] metres in that time, and with only 2 men instead of 6. A six horse-power engine is required to work 2 machines; the air is compressed to 1½ atmospheres. For one working machine it requires 2 in reserve. The speed per minute is $0^{m}.03$, including replacing the drills. Each drill will not bore more than $0^{m}.20$ to $0^{m}.30$ without being replaced. Its speed of advance at Vieille Montagne over ordinary borers may be considered to have been treble in hard rock, but only double in soft rock.

This apparatus of Döring weighs 45 kilogrammes, and constitutes the borer, properly so called. It is erected upon a special carriage, which allows any direction to be given to the drill that is desired. The pressure of the air varies from ¾ of an atmosphere to 1½. This machine is composed of a cylinder $0^{m}.400$ in diameter, and $0^{m}.300$ long. In this cylinder a piston moves, to which is fixed the stem of the drill. The compressed air is distributed by means of a slide valve, and, after acting freely, escapes into the air. Two ratchet wheels, furnished with dogs, are placed at the back of the cylinder, and are put in action by the prolonged rod of the piston by means of a fork which commands the dogs. One of the ratchet wheels serves to give to the drill a rotary movement on its axis; the other ratchet, which is nearest to the cylinder, by means of a toothed wheel advances the tool upon the support. The arrangement is such that the drill advances only when the piston has run its stroke. A jet of water is constantly thrown into the hole for the removal of the débris. The drill most used is pointed in the form of the letter Z; and it is found that when worked in the machine it does not blunt as rapidly as when worked by hand.

Mr. Döring has put his machines into operation in a very deep mine—the Tincroft, in Cornwall—where the rock is the hardest in that country, and one is to be introduced at the Dolcoath mine. It is represented as making good headway in the hard rock of the Tincroft.

BERGSTRÖM'S DRILLING MACHINE.

Bergström's drilling machine originated in Sweden, and has been in use there at the Persberg mine. A machine exhibited at Paris in 1867 was said to have worked for 700 days under ground, and to have bored in the aggregate 1,000 metres. Upon hard granite, in trials with the drill, it bored 2 metres in 1 hour. The drill is impelled by compressed air, in a cylinder similar to that of Döring's machine, but without an automatic advance movement. It gives from 300 to 400 blows per minute, and the diameter of the drills varies from $0^{m}.018$ to $0^{m}.025$. The weight of the whole apparatus is only 120 pounds, and it is supported upon a steel bar, which must be fixed in a direction parallel to that of the intended bore-hole. The cylinder is made to travel along this bar.

It may here be mentioned that in 1856 Karl Schumann, of Freiberg, Saxony, constructed a boring machine, to which those above described and the drill of General Haupt are similar in some respects.

HAUPT'S DRILL.

This percussion borer differs essentially in its construction from those described. It works by means of steam. The drill passes down a hollow piston rod, to which it is fixed by the extremity which is before the workman. The reciprocating movement is communicated directly to the drill, and by a special arrangement of the slide valve the introduction of the steam into the cylinder is avoided until the piston has arrived at the end of its forward stroke.

The force of the blow of the drill upon the rock depends on pressure of the steam upon the piston. It will be observed, bes that the useful effect of the drill depends much more upon the se of the piston and the pressure of the steam, than on the length o stroke of the piston, and that the consumption is proportioned to last dimension. The length of the stroke of the piston is $0^m.102$, an number of blows per minute is 375.

The movement of rotation is given to the drill in the following The box in which the shaft of the drill is held, and which turns wi carries a ratchet wheel on one part of its circumference, and ar this wheel is a ring furnished with a pawl, which catches in the tee the ratchet wheel. This ring also carries a projecting tappet, w passes in an inclined groove left in the outer envelope of sheet which surrounds the steam cylinder. The tappet participates in movement of the piston and drill, and by sliding in the inclined gr turns a screw with which it is combined, and by means of the gives the ratchet wheel and the drill a rotary motion.

This arrangement would be insufficient alone, since the tappet ing in both directions in the groove destroys, to a certain extent, du the forward stroke, the useful effect produced during the back st To obviate this imperfection, and to maintain the rotation transmi to the drill, there is a second ratchet wheel placed at the front en the box that carries the drill. A steel spindle placed in a recess for by the cylinder jacket locks into the teeth of this second ratchet w so that the movement of rotation only takes place one way. The ratchet wheel allows the transmission of the rotating movement to tool; the second forces this movement to be always effected one wa

Mr. Haupt has contrived a special arrangement which causes drill to always strike upon the rock with the same force, and to var advance according to the hardness of the rock. If the drill is put i the drill-carrier in such manner that at any given time the motio this latter can be suddenly arrested while the tool itself continue move, it is clear that each stoppage of the tool-carrier will be follo by an advance of the tool; but as this stoppage would diminish force of the blow upon the bottom of the hole, it is only allowed to t place at intervals.

Mr. Haupt estimates that three horse-power is required for e borer, and that the rate of progress in rocks of ordinary hardnes $0^m.05$ per minute.

BEAUMONT AND LOCOCK'S DRILLING ENGINE.

This machine is worked by compressed air; its object is to pier gallery of two metres diameter entirely by the machine, aided by pow for disengaging the core of rock which is left in the middle of the nular trench cut by the drills.

This machine is composed of a cast-iron plate which carries on circumference thirty-six drills made of cast steel, and in its cente similar drill. The diameter of the plate is about two metres, and the same as that of the gallery to be driven. It is fixed on a hol iron shaft, about two-thirds of its length being a piston, which mo in a cylinder.

The stroke of the piston is about $0^m.30$. A slide valve introdu the air (compressed to two atmospheres) to each face of the piston, gives it an alternate movement of 250 blows per minute. A wor worked by a special mechanism, turns the axle with the drills by mea a screw wheel combined with the axle. The carriage on which the ston shaft is mounted receives a forward motion by a special ar-ngement. The water which is thrown into the groove formed by the ills enters the interior of the shaft, and by pipes branched upon this le is conducted to the circumference of the plate.

This is evidently one of those machines that cannot long withstand e extreme violence of the impact essential to rapid drilling. If it is most impossible to construct a machine with one drill that will work ng enough without repairs to make it an economical success compared ith hand labor, how much can we expect from an engine armed with irty-seven drills, all rigidly attached to one piston?

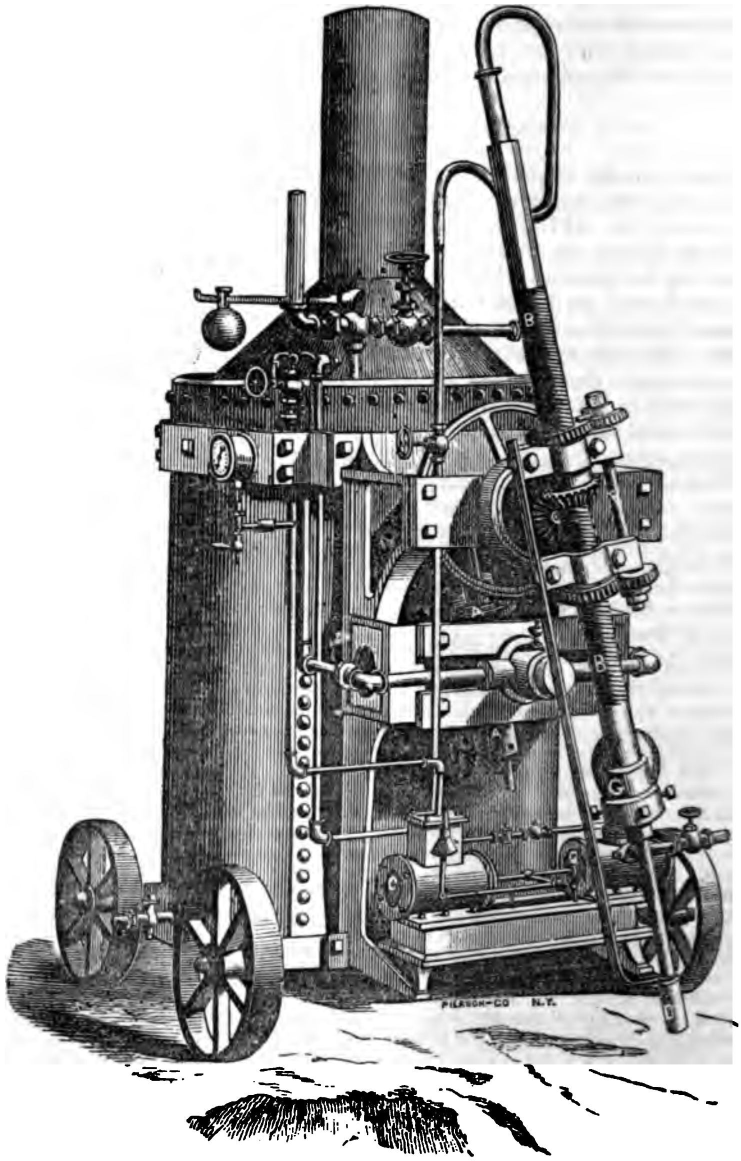
FORD'S DRILLING MACHINE.

A power-drilling machine has been constructed and put into opera-on in one of the mines at Sandhurst, Australia, and is said to effect a ry considerable saving over the ordinary process of drilling by hand. r. Joseph Millin, the manager of the Hustler's Reef Company, states at drilling in ground that would cost forty shillings per foot with nd labor can be wrought with the machine for thirty shillings; or, if ith hand labor at sixty or eighty shillings, with the machine for forty illings. The harder the ground the greater the saving. The machine pears, from the description given, to be similar in construction to the rleigh drill. The constructor, Mr. R. G. Ford, of Sandhurst, de-ribes the drill as follows:

> In Ford's rock-boring machine the motion of the rock-boring tool is reciprocating, d the motive power is compressed air or steam, at a pressure of sixty pounds per uare inch, acting on a piston in a cylinder. It presses constantly on a small annular ace in front of the piston, and intermittingly on the whole area of the back of the ston; a percussive action is thus given by the borer carried by the piston rod. The rts for the alternate admission of the compressed air behind the piston, and for the haust, are opened and closed by a valve worked by a small piston, thus securing the ll pressure on the back of the piston, and giving a free blow and a clear exhaust for e return stroke.
>
> The air-ports and the movement of the valve are so arranged that the piston cannot rike the front and back of the cylinder. The rotation of the boring tool is self-acting, d is caused by the piston rod working a ratchet and click round a cylinder attached the front of the working cylinder, and as the piston reciprocates it carries itself und the cylinder and makes a complete revolution every twenty-one blows, by which eans the machine bores a perfectly round hole, and the drill cannot move more or less han a twenty-first part of a revolution at each stroke. The feed is self-advancing and lf-adjustable and variable, feeding with precision as fast as the tool has power to enetrate the rock, but no faster, varying its feed in the same hole with the varying ardness of the rock or sharpness of the tool. This is effected by the working cylinder eing provided with an exterior cylinder in which it can slide, and the compressed air constantly tending to propel the working cylinder forward, but is retained by a rew, which is prevented from turning by a pawl, which the piston strikes when it akes a full stroke, thus releasing the screw and permitting the working cylinder to dvance forward as the hole increases in depth.
>
> An ordinary drill is used; the only alteration required is the head, which is made to t the machine. The drills can be made to bore holes from three-quarters of an inch two inches in diameter. The weight of the blow struck by the machine can be aried from 1 pound to 510 pounds, and the number of blows from 20 to 600 per minute, y the attendant simply moving the handle of a small air-cock.

The air-compressor used at this mine with Ford's machine is very imple, consisting of a cylinder nine inches in diameter, bent like the etter U, with a piston working in one leg only, the other being filled ith water. The piston has a stroke of two feet, and as it moves up d down in one leg the water rises and falls in the other, thus making double-acting. The piston works through a stuffing-box at the bottom, d the inlet and outlet valves are placed at the top. A small supply of water is admitted at the inlet valve with each stroke, and is thro into the receiver at each return stroke, thus circulating through apparatus, and carrying off the heat given out by the air when co pressed. An old boiler is used as the receiver, and the compressed is conveyed to the drilling machine in iron gas-piping.

LESCHOT'S ANNULAR DIAMOND DRILL.



Diamond Drill for testing or prospecting.

The drills about to be described work upon an entirely different princi ple from those noticed in the preceding pages. The latter are all of th lass of percussion drills, and cut by the force of the blow concentrated t the point of the drill. The diamond drill, on the contrary, is not sed percussively, but by virtue of its extreme hardness it is made to ut away the rock by contact and pressure. The drill is pressed rmly, and is rapidly rotated against the rock to be bored.

The application of rough black diamonds to boring and cutting into ocks was made in 1860, by Mr. Rodolphe Leschot, a civil engineer reiding in Paris, and formerly a student in the École Centrale. He found y experimenting that such diamonds, firmly set in the end of an iron or teel tube or cylinder, could be made to bore holes in rock to great depths nd with a rapidity before unknown.

A short section of a cylinder of soft steel is used for the purpose. It aries from one to three or more inches in diameter, according to the ize of the hole to be drilled, and is only about one-quarter of an inch hick. Cavities are drilled in the end of the cylinder, and into these avities black diamonds of the common or bort variety are firmly set, y hammering up the soft metal around them. They are allowed to roject about half a millimetre in front and slightly beyond the outer nd inner surface of the cylinder or ring. This ring is secured by means f a bayonet joint or screw thread upon the end of a long hollow rod or rill bar, to which a rapid rotation is given. By pressing or feeding this evolving diamond-mounted ring against the rock to be cut, and at the ame time supplying it freely with cold water, the rock, whether of soft r hard materials, of clay, slate, or of flint, is rapidly worn away, and an nnular cutting results, leaving a central core of rock, which passes nto the center of the drill and drill holder, and may be broken out when he drill is withdrawn, thus leaving a truly cylindrical hole with smooth ides.

The rapidity with which this apparently delicate ring cuts its way nto the hardest syenite, quartz, or granite is surprising. The first experiments showed that two men with a machine like an ordinary feed rill could bore 0m.025 in depth per hour. The cylindrical core left in he center was 0m.031 in diameter and the annular groove 0m.043 in iameter; consequently the part cut out was equal to a cylinder 0m.012 hick. But this method of feeding or advancing the drill was clearly ery defective, no allowance being made for the varying hardness of he rock. Since that time very great improvements in the way of mounting, operating, and feeding the drills have been made.

The wood-cut represents the drill and its mounting, as manufactured y Messrs. Severance & Holt, the assignees of the patent for the United States. This form is known as the "testing or prospecting rill," and it is designed chiefly for testing the character and value of mineral deposits, although it is adapted to a variety of other work, such as drilling holes in quarries for blasting, and for well-boring.

It consists of a small, upright boiler, to one side of which is firmly bolted the cast-ron frame which supports the engine and swivel, drill-head, gears, and screw shaft, as hown in the engraving. The engine—an oscillator of from five to seven horse power—s shown at A. B is the screw shaft with drill passing through it. This shaft is made f hydraulic pipe from five to seven feet in length, with a coarse thread cut on the utside. This thread, a portion of which is shown in the cut, runs the entire length the shaft, which also carries a spline by which it is feathered to its upper sleeve-gear. his gear is double, and connects by its lower teeth with the beveled driving-gear, nd by its upper teeth with the release-gear (E.) This release-gear is feathered to e feed shaft, (F,)at the bottom of which is a frictional gear fitting the lower gear on e screw shaft, which has one or more teeth less than the frictional gear, whereby a ferential feed is produced. This frictional gear is attached to bottom of feed shaft) by a friction nut, thus producing a combined differential and frictional feed which nders the drill perfectly sensitive to the character of the rock through which it is passing, and maintains a uniform pressure upon the same. The severe and sudden strain upon the cutting points incidental to drilling through soft into hard rock with a positive feed is thus avoided. The drill proper (passing through the screw shaft B) consists of a tubular bar, made of lap-weld pipe, with a steel bit or boring-head (D) screwed on to one end. This bit is a steel thimble about four inches in length, having three rows of black diamonds in their natural rough state firmly imbedded therein, so that the edges of those in one row project forward from its face, while the edges of those in the other two rows project from the outer and inner peripheries respectively. The diamonds of the first-mentioned row cut the path of the drill in its forward progress, while those upon the outer and inner periphery of the tool enlarge the cavity around the same, and admit the free ingress and egress of the water as hereafter described. As the drill passes into the rock, cutting an annular channel, that portion of stone encircled by this channel is of course undisturbed, and passes up into the drill in the form of a solid cylinder. This core is drawn out with the drill in sections sometimes of from 8 to 10 feet in length.

The sides of the hollow bit are one-fourth of an inch thick, and the diamonds of the inner row project about one-eighth of an inch, so that the core or cylinder produced by a two-inch drill (the ordinary size for testing) is one and a quarter inches in diameter.

Inside the bit (D) is placed a self-adjusting wedge which allows the core to pass up into the drill without hinderance, but which impinges upon and holds it fast when the action of the drill is reversed—thus breaking it off at the bottom and bringing it to the surface when the drill is withdrawn.

In order to withdraw the drill it is only necessary to throw out the release-gear (E) by sliding it up to the feed shaft, (F,) to which it is feathered, when the drill runs up with the same motion of the engine which carried it down, but with a velocity sixty times greater; that is, the speed with which the drill leaves the rock, bringing the core with it, is to the speed with which it penetrates it as sixty to one—the revolving velocity in both cases being the same.

The drill rod may be extended to any desirable length by simply adding fresh pieces of pipe. Common gas-pipe, or, better, lap-welded iron tube, is found to serve admirably for this purpose, the successive lengths being quickly coupled together by an inside coupling four inches long, with a hole through the center of each to admit the water. The drill is held firmly in its place by the chuck (G) at the bottom of the screw shaft.

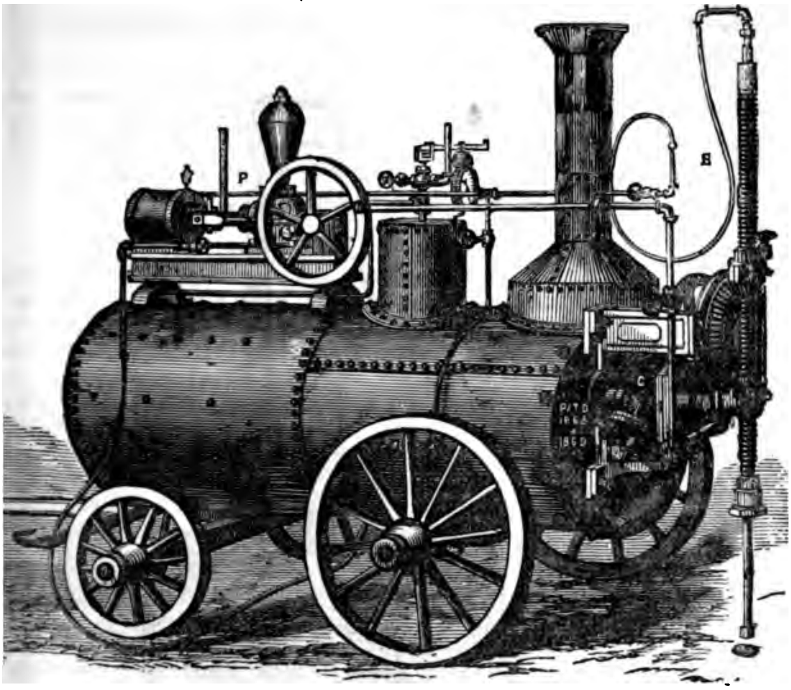
The small steam pump (C C) is connected by rubber hose with any convenient stream or reservoir of water, and also with the outer end of the drill pipe by a similar hose having a swivel-joint, as shown in the picture. Through this hose a steady stream of water is forced by the pump into the drill from which it escapes between the diamond teeth at the bottom of the bit, (D,) and passes rapidly out of the hole at the surface of the rock, carrying away all the grit and borings produced by the drill. Where water is scarce or difficult of access, a spout is laid from the mouth of the hole to the tank or reservoir and a strainer attached to the connecting hose, so that the same water may be used over and over again with but little loss. This pump also supplies the boiler.

The same parties manufacture another style of prospecting drill, similar in its construction to that just described, but larger and more powerful. It has a horizontal tubular boiler 3½ by 7 feet, with flues three inches in diameter, and steam capacity equal to twelve horse-power. The engines are two oscillators of 4¾-inch cylinder, five-inch stroke, and both attached to the same crank shaft. The whole is mounted upon wheels so as to be portable. It is geared to run with twice the speed of the first-described machine. Its construction and general appearance is shown by the cut. The pump P and water hose H fill the same offices as thôse in the upright machine. This pattern is mounted on large wheels with broad felloes for easy transportation in rough mining districts, and, like No. 1, is all complete in itself.

It is especially adapted to well boring, draining, and prospecting, and will bore holes from two (2) to five (5) inches in diameter, as desired, and to any required depth. The total weight is about 3,800 pounds.

An open cut or quarry drill is also made. It is similar in its construction to the last-described machine without the boiler, and has two oscillating engines, B B, of five horse-power each, and is geared three to one. This machine gives to its drill rod 900 to 1,000 revolutions per minute, and drills in ordinary rock at the rate of fifteen to twenty

per hour. It is adapted to either compressed air or steam. A pow-
l plunger pump is represented at A.

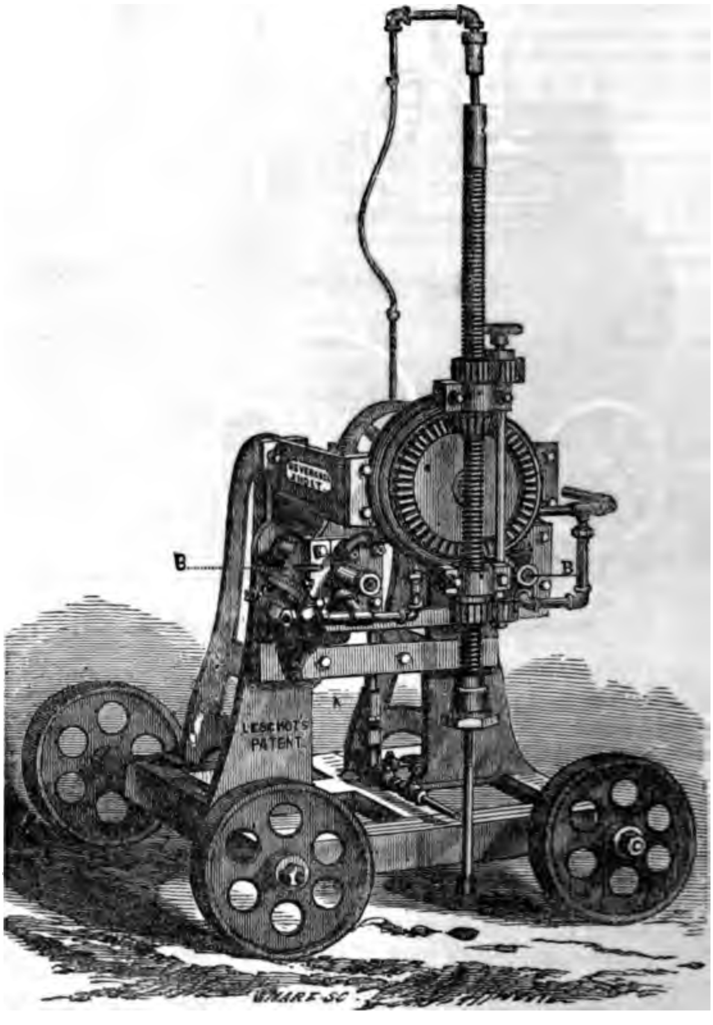


Severance & Holt's Portable Prospecting Drill.

ıe speed of boring of course depends upon the character of the rock,
ing from five feet per hour in very hard rock to fifteen feet per hour
nestone, sand rock, and shale. The rate of speed in drilling appears
: limited only by the velocity with which it is possible to rotate the
It is claimed that with one thousand revolutions per minute the
est rock may be drilled from eight to ten feet per hour, the diamonds
ng only the one-four-hundredth part of an inch at each revolution,
the drill thus advancing one inch for every four hundred revolutions.
:is is the finest or slowest "feed," and is used only in flint or rocks
eatest hardness; while in ordinary rock the drill is fed at the rate
ıree hundred revolutions to the inch—the diamonds, of course, cut-
the one-three-hundredth part of an inch at each revolution; and in
ıle, sandstone, &c., at the rate of an inch for every two hundred revo-
ns. The pressure of the bit or drill head against the rock does not
nd upon the length and weight of the drill rod, and is no greater at
.epth of a hundred feet than when entering the rock at the surface.
e variations in the feed are effected by simply changing one gear-
l, requiring less than five minutes' time. The same machine will
holes from one to four inches in diameter, as desired.

e diamond teeth are the only parts of the tool which come in con-
vith the rock, and their hardness is such that more than two thou-
feet have been drilled by the same points with but little apprecia-
ear. The cost of resetting the diamonds so as to present new
s is very slight, and no special skill is required for the operation.

Other repairs are seldom needed. The diamonds vary in price from six to seven dollars per carat, gold. Some of them are light-colored, translucent stones, nearly one-quarter of an inch in diameter. The usual diameter of bits for drilling blast holes in mines is one and a half inch, carrying six diamonds.



Open Cut or Quarry Drill.

The peculiar shape of the boring bit prevents the drill from running out of line; hence the hole bored, however deep it may be, is perfectly straight and there is no friction of the drill against the rock.

The manufacturers have made another boring head of similar construction, but having the annular opening partially closed and the diamonds so arranged as to bore out the entire hole instead of producing the core. This form of bit, however, is not desirable, as it requires far more power to drive it, consumes more diamonds, and is not available

boring deep holes on account of its tendency to deviate from a true
e.

The annular diamond drill has been used for testing the nature of the
ks at considerable depths in many places, and it is evidently destined to
of very great service to mining industry. Rock-cylinders or cores have
n repeatedly taken out from a depth of 300 to 400 feet, and they give
erfect record of the succession of the rock deposits, or veins passed
ough. At the lead mines in St. Francis County, Missouri, test holes
e been bored at several points from sixty-five to one hundred and fifty
t in depth, and have proved the existence of deposits of ore not before
own. At the Portland, Connecticut, sandstone quarries, a test hole has
n bored and cores obtained to a depth of 312 feet. In Essex County,
w York, the drill has been used upon the ore-bed of Witherbees, Sher-
n & Co., and gave a continuous core to a depth of 340 feet in very hard
k, and in the compact iron ore, thus showing the nature of the forma-
n to that depth. In Pennsylvania, at the William Penn Colliery, the
ll has been used to prospect for the "Mammoth Vein." The drills were
t into operation at the bottom of a shaft already sunk 170 feet. In six
urs and forty-seven minutes, actual running time, the drill penetrated
an additional depth of 104 feet 11 inches. Of this, 46 feet and 1 inch
s through slate and coal alternating and mixed, and 58 feet 10 inches
rough anthracite coal, the bed dipping at about 45 degrees. The
erage rate of boring was 3.06 inches per minute for the whole depth,
about 15½ feet an hour. The proprietors write:

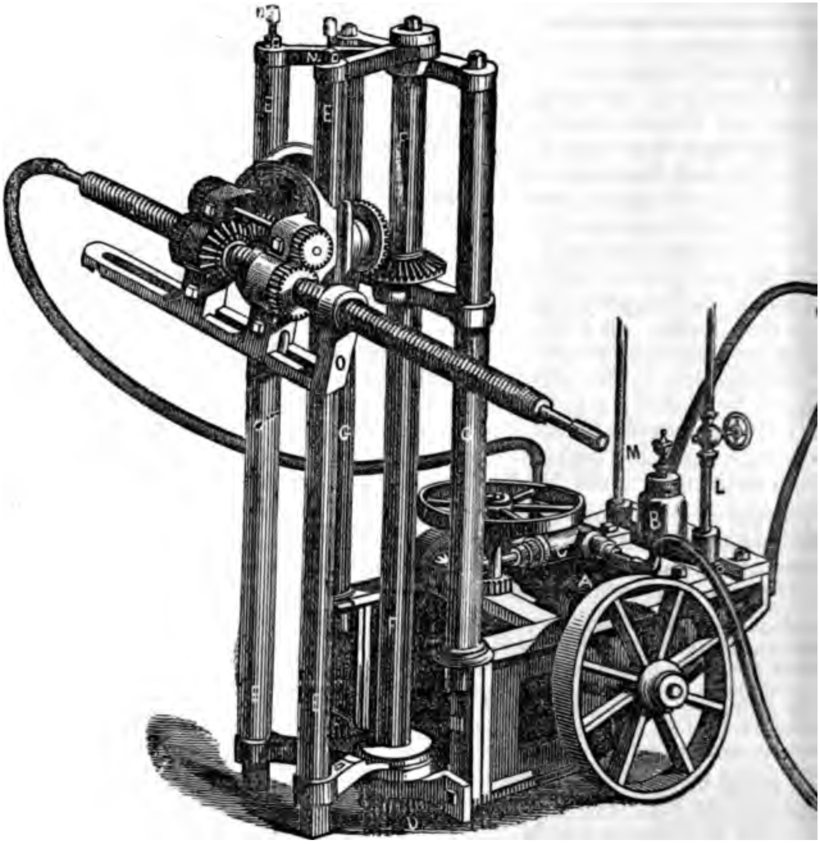
> Ve are satisfied that we could have bored through hard rock at the same uniform
> e, for the slate bored through contains "sulphur balls" of the size of a goose egg, and
> ward, of sulphuret of iron, of intense hardness, but which formed no more serious
> structions to the drill than the conglomerate rock. With the exception of one im-
> rfect diamond, we could not perceive the least effect or abrasion on the surface of the
> monds, even with a magnifying glass. We afterward tried the same machine for
> ring blast holes in the coal at bottom of shaft with equally satisfactory results. The
> l was such as experienced miners could drill five feet per hour in by hand; the ma-
> ine bored it at the rate of twenty-two inches per minute, to the no small surprise of
> r veteran miners.

It is found to work well upon hard trap rock, in which it is almost im-
ssible to drill a hole of uniform size with hand drills, or to drill more
an about ten feet in depth. In this rock, upon the New Haven and
'illimantic railroad, it is found by experience that where only from 8
12 feet of drilling could be made by hand in one day by three men,
orking by the foot, a machine will drill from 30 to 36 feet. Two ma-
ines are used and they give holes two inches in diameter and uniform
roughout their depth—from 18 to 30 feet. It is found very advan-
geous to drill from two to four holes and to explode the charges in
em simultaneously. By boring five holes to the depth of the grade,
d exploding the charges all at once by the battery, it is possible to re-
ove twenty-four feet in length of the rock in the cut at one blast.

Some interesting results have been obtained with the drill in subma-
ne boring at Hell Gate. The reef of rock to be removed lies from
elve to twenty feet below the surface of the water at high tide. The
achine was so placed, just above the water, upon a trestle-work or
ging, that the drill could be placed in contact with the rock twelve
t below. The drill penetrated at the rate of 6½ feet per hour, and
o holes 32 feet deep and 2½ inches in diameter were drilled in a short
e. Its performance at that place has given great satisfaction.

The annexed figure shows the construction of a machine for drilling
mines or tunnels varying from four to sixteen feet high. It is ope-

rated by steam and is portable, being nearly balanced upon the t wheels. By depressing the handle H it can be trundled about.



Diamond Drill for mines.

The upright frame (E E) which supports the swivel drill-head with its gears drill, is attached by hinge-plates to the top and bottom of the driving shaft (F) may be swung to the right or left, describing a semi-circle. This permits drillin any angle of the horizontal arc thus described without moving the machine, and placing the drill-rod close up to the side wall of the tunnel. The drill-head also up and down this adjustable frame (E E) and can be secured at any point so as to b perpendicular row of horizontal holes, without incurring more than three or four utes' delay in adjusting the drill to each successive hole.

The drill itself with its feed-gears and sliding guide (O) may be turned compl round by simply loosening a nut on the back of the swivel head so that the point o drill shall describe a vertical circle, at any angle of which it will bore equally well

The two uprights (G G) are used to support the driving shaft, (F.) They are of common hydraulic pipe, and may be lengthened or shortened at pleasure, accor to the height of the tunnel. The driving shaft (F) has a sliding gear attached feather and spline adjustable at any position as shown in the cut. The sliding just beneath this gear is used to steady the driving shaft. Motion is communicate this shaft by means of the gear at the bottom, (D.) The hollow frame posts (E E) set firmly against the upper wall by means of extension screws (N N) which ma run up two or three feet if desired. The engine, water apparatus, feed-gears and are the same as in the prospecting drill, and the mode of operation is essentially same. When it is desired to produce holes less than one or one and a quarter in diameter, it is usual to set the diamonds so as to cut out all the rock, but otherwise nular bit is preferable. The steam or compressed air is brought through rubber hose m any convenient distance and introduced into the engine by pipe, (L.) (M) is the haust pipe. This drill being used to bore short holes, may be run much faster than other, 900 revolutions per minute being a fair rate of speed. The feed may be ried at pleasure, and according to the hardness of the rock from 90 to 340 revolutions r inch, which gives from two to ten inches per minute. The same advantages are ured by friction feed in this drill as in the larger one.

The Leschot drill has recently been introduced in California and is practical operation in Colorado Territory, at Clinton Gulch, in a tun- l belonging to the Consolidated Bullion and Incas Mining Company. was desired to prove the ground in advance of the end of the pros- cting tunnel, 600 feet long, and by means of the drill a hole was made 7½ feet, horizontally, in advance, and a core brought out so as to show e nature of the rock for the whole distance. The machine was placed the tunnel 600 feet from the outer air and was moved by compressed r, supplied from a compresser outside.

At Shenandoah, Schuylkill County, Pennsylvania, the drill has bored hole 274 feet deep, through shale, sandstone, and coal, at the rate of m 20 to 25 feet a day, including the time occupied in taking out the re. Where it is not essential to obtain a test core, a much more rapid te of progress may be attained.

DE LA ROCHE-TOLLAY AND PERRET'S BORING APPARATUS.

In France considerable attention has been given to perfecting ma- iinery for supporting in the proper positions and giving motion to the amond drill, and at the Paris Universal Exposition of 1867 the drill uld be seen daily in operation, driven by water power and boring les into the hardest granite. The motor was a small water-pressure gine, contrived by Mr. Perret, of Bordeaux. This consists of a brass linder, $0^{m}.055$ inside diameter, in which a piston works back and forth the alternate pressure of the water on the faces. The length of roke was $0^{m}.120$, and the motion was changed from reciprocating to tary by a connecting rod and crank. It was run with water, the essure of which varied from 3 to 9½ atmospheres; and it is claimed that der the maximum pressure from 47 to 57 per cent. of the theoretical fect was realized.

The drill-bar consists of a six-sided cast-steel shaft, $1^{m}.45$ long, bored roughout its entire length with a hole $0^{m}.016$ in diameter. The dia- ond-armed ring is mounted upon one end of this hollow hexagonal ill-bar, and at the other end is a brass piston, $0^{m}.11$ in diameter, upon hich the water is allowed to press, so as to keep the ring firmly against e face of the rock to be bored. This pressure is varied with the hard- ss of the rock. A pressure of eight atmospheres is sufficient for hard cks, such as quartz and granite. For calcareous rocks, such as lime- tones and marbles, five or six atmospheres is sufficient. The tool makes bout 200 revolutions a minute. By the injection of water through the llow drill-bar the powder of the rock is washed out as fast as formed d the drill is kept cool. The drill-bar receives its motion by means of vel gearing.

The following are some of the results of the experiments made during e progress of the Exposition. The pressure upon the feeding or ad- ncing piston, forcing the drill forward, was equal to eight atmo- heres, and the speed of rotation varied from 200 to 280 revolutions per nute. The rate of advance was as follows:

solid Mont Cenis quartz	$0^{m}.054$ per minute.
Morvan porphyries	$0^{m}.042$ per minute.

> difficulties have disappeared. We have examined two rings which were
> seven months at the Exposition, and which have perfectly resisted. We b
> we can affirm that in a hard stone like granite, a ring properly worked will
> to an aggregate depth of 150 metres. A ring for boring holes $0^{m}.036$ dia
> about 150 francs, but as the black and opaque diamonds used in its const
> ordinarily employed in the shape of dust for polishing transparent diamon
> their wear during the act of perforation is very slight, they can be extracte
> socket in which they are set, and be returned to the trade with a depreciati
> tionate only to the diminution of weight. The diamonds extracted from
> ring generally fetch from seventy to eighty francs—that is to say, about
> their first cost.

It is the opinion of Messrs. Huet and Geyler, who, with Mr. I
reported upon this drilling machine, that it must, in time, supe
percussion drills; and they are confident that it could be used
vantageously to replace the percussion drills at Mont Cenis.
mark:

> We cannot refrain from making a comparison between this perforator a
> employed at Mont Cenis. Its solidity, proved by seven months' work, gives
> ance that twenty to twenty-two of these perforators would be sufficient for
> of both galleries, including duplicates, instead of at least two hundred a
> actually existing. Mr. Sommeiller's perforators cost the same as those of
> La Roche-Tollay and Perret. The staff would be four times less, for one ma
> attend four perforators; thus four men instead of sixteen would suffice f
> four hours at the two galleries.
>
> The repairs to the rings require neither forges, lathes, nor workshops; and
> vinced that a workman to each gallery would be sufficient for the repairs of
> forators. We have stated that the rate of advance in the Mont Cenis quartz
> per minute, under a pressure of 874 kilogrammes on the propelling piston:
> hole $0^{m}.90$ could have been driven in 16 minutes, say 20, and as each perfora
> make 10 holes, say 3¼ hours, even doubling this time for preparing the work
> seen that five stopes can be done in two days, including the time for blasting
> ing away the debris, which is equivalent to an advance of $2^{m}.25$ per diem,
> barely $0^{m}.50$, the actual rate of advance.
>
> The apparatus of Messrs. De La Roche-Tollay and Perret is not subject
> shock; the pressure is exerted on the rock irrespective of the speed of the
> such pressure can be regulated as may be desired; and when water power is
> which is generally the case in mines and tunnels, the motive power actu

them. After having seen the operation of the drills, and the great riety of samples of cores of the hard rocks, such as syenite, granite, trap, mpact quartz, magnetic iron ore, marble, &c., which have been taken t by their use, and after reading many of the letters from various rts of the country, giving the most satisfactory reports of the opera-n of the drill in prospecting and in quarrying, I am satisfied that it ould be commended to the attention of miners and prospectors every-ere, as one of the greatest aids they can have in ascertaining the ture of veins and beds at considerable distances, either from the sur-ce or from the deepest or remotest points reached in their mines. The ospective value of many mines may, by means of this drill, be very eely and economically ascertained. It may be made of immense ser-ce not only in mines where the veins are pinched and of doubtful value, t in those veins that have always been of good size and value. It ould, for example, be important and highly satisfactory to ascertain hether the rich vein of the Eureka Mine, at Grass Valley, California, ntinues to have nearly the same character and gold-bearing value for 0 or 500 feet below the present workings. The shafts and prepara-ons for working could then with great propriety be projected upon a ale commensurate with the work evidently to be done. So, also, in spect to the Amador Mine, Sutter Creek, the Sierra Buttes, and other oted mines of California, and the Comstock lode in Nevada. There is least one prominent case where this testing drill could be made of eat service—at the Princeton vein, on the Mariposa Estate. The hoot of ore in this vein plunges at an angle of about 17° to the south-st, and has been worked about as far as it can be economically in that irection; and it is very desirable to know whether the shoot continues ith the same inclination and richness far beyond the present excava-ions. If it does, it will be advisable to sink another shaft to intersect hat part of the lode. A test hole could be sunk in a few weeks by eans of this drill, and a core, showing the thickness and nature of the ein at that point obtained at trifling expense, compared with the cost f sinking a shaft or running a tunnel.

It is probable that the annular diamond drill may be advantageously sed for cutting shafts of large diameter, inasmuch as the ratio of the uantity of material cut away to the size of the hole bored becomes less nd less as the diameter of the bore increases. A large core would be ft, but this could be readily broken out by blasting in a central hole. Among the great advantages of such shafts would be their truly cyl-ndrical form and smooth sides.

CHAPTER LXVIII.

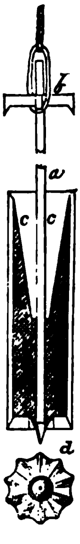
BORING DEEP WELLS FOR WATER AND OIL

Within ten years seventy-five artesian wells have been bored in the sert of Sahara, yielding in the aggregate 45,000 litres of water per inute, or 64,800 cubic metres in twenty-four hours. A part of this sert has been made fertile; two villages have been created in the idst of the former solitudes, and 150,000 palm trees have been planted more than a thousand new gardens. This is an indication of the great sults in store for those who may undertake the work of supplying ater to the marvelously rich soil of the Colorado desert in California. e strong arm of the government should be reached out in the initia-

tive to restore fertility to such a broad area of the public la
not only worthless but a positive barrier to the settlement of
of the country, and to transportation between the coast regio
interior.

Artesian well-boring has been practiced in California since ab
when several wells were pierced in the recent strata overlying
formations of San Francisco. Since then a great number of t
the Santa Clara and San José valleys, and in other portions of
have been very successful. At Stockton a well has been pi
great depth, and an abundant supply of potable water obtain
rises above the surface and supplies the city. The great tr
valleys and basin-shaped depressions throughout California, Ne
adjoining regions present conditions favorable to the success o
borings; and although an overflowing fountain cannot in al
expected, yet there is little reason to doubt that an abunda
may be obtained from the borings by pumping. The Sacram
Joaquin, and Tulare valleys, all invite a resort to artesian b
water to irrigate their lower and more arid portions, where in
mer the drought is excessive. The Colorado desert, already m
is another region where artesian borings may supply the only
for extreme fertility.

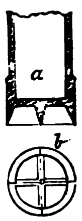
The most simple and the most ancient form of apparatus fo
the earth to great depths is that adopted by the Chinese. I
of a rope armed at the lower end with a tool of iron or steel.
indebted for some of the earliest information in detail upon th
to the missionary, Imbert, in 1827, who reported that in the Pr
Ou-Tong-Kiao there were many thousand borings within an ar
leagues by ten, carried to a depth of nearly 1,800 feet in searc
water and petroleum. Some of these borings, after the exh
their brine, had been pierced to the depth of 3,000 feet, and ha
sources of carbureted hydrogen gas, which was used to pr
heat necessary for the concentration of the saline water.



A simple derrick, with a pulley above, and reel below from
rope is unwound as the hole deepens, is nearly all that is re
sides the perforating tools. Cords are attached by
clamps to the rope between the pulley and the reel, an
ing upon these cords the drill is alternately raised and
The vertical movement of the drill ranges from one to
or more. The drills are made in various forms accordi
nature of the rock to be penetrated. A French eng
Jobard, uses a heavy cylindrical head of chilled cas
tached to a long iron rod, as shown in section by t
The extremity of this rod is armed with a steel point, w
jects below the cutting face of the cylinder, and serves
the hole like the point of a carpenter's center-bit.

The surface of this cylindrical drill-head is channele
give room for the powder formed by the cutting to ris
it, and the upper part is provided with a conical cavit
which the loosened materials fall, and are removed fro
when the drill is drawn out. The small figure, *d*, belo
tion, is a view of the end of the drill, and shows the arr
of the cutting edges and grooves. The rod *a* may
yards long, and is provided at the top with cross-bars c
intended to act as guides to keep the tool vertical. I
sired to make the hole larger, in order to introduce tu

only necessary to suspend the tool a little to one side of the axis, it will then hang with more less inclination in the hole, and cut out the sides in its descent. This would not be safe in loose rock.



Another form of drill was designed and has been most successfully used by M. Goulet-Collet, of Rheims. It consists of a cylinder of heavy sheet-iron, two metres in length, suspended by a chain, and armed at its lower end with an annular cutting head of steel, *a*, in which two knives or chisels are placed across the opening, as shown in the end view at *b*. These chisels serve to cut the rock, while the water and sand are free to rise through the cylinder. The removal of the debris is effected by another tool, although this cylinder may be provided with valves like a sand-pump, and thus serve the double purpose of drill and pump.

When the rocks are not too hard for this form of tool they may be pierced with great rapidity. According to M. Debette, from whose description the foregoing is compiled, M. Goulet-Collet, with two workmen, could bore from eight to eleven metres a day in the chalk of the cretaceous formations of Champagne. He would also contract to bore wells to any required depth for nine francs per metre. He had made in the course of several years nearly one hundred borings, and each had given good water, for a total cost ranging from 150 to 300 francs. The apparatus did not cost over 500 francs.

The methods of boring employed in California are substantially the same as those for oil wells, to be hereafter described. The rope is used in preference to rods, and there is no peculiarity in the method worthy of special notice.

In Europe boring with rods rather than rope is preferred. These rods are made of elastic wood, or of the best quality of iron. In the latter case the sectional area depends upon the depth to which the hole is to be bored, varying as shown by the annexed table:

Depth of hole.	Diameter of hole.	Sectional area of rods.
Metres.	*Metres.*	*Metres.*
0 to 50	0.05 to 0. 6	0.025
50 to 100	0.06 to 0.10	0.030
100 to 200	0.10 to 0.15	0.032
200 and beyond.	0.15 to 0.25	0.045

At Cessingen a well has been bored to a depth of 535 metres, with rods of $0^{m}.025$ section. The length of rods is limited only by the height of the derricks. It is usually between four and eight metres.

As already remarked, great improvements have of late been made in the apparatus for boring to great depths, and especially for sinking wells several feet in diameter. The success attending the boring of the celebrated well at Grenelle, Paris, has led to the sinking of still larger ones, in order to give a more abundant supply of water and meet the necessities of a rapidly increasing population. In 1867 two wells were in progress—one in the suburb of La Chapelle, in the northern portion of the city of Paris, by MM. Degousée and Laurent, and the other at Butte-aux-Cailles, in the extreme south of the city, by M. Dru, formerly Mulot & Dru. These new wells were to be, the one five feet in diameter, and the other about four feet. The following are the depths and dimensions of the older wells: Height above the sea, at Grenelle, 121.3 feet; at Passy, 305.2 feet; depth of bore-hole, at Grenelle, 1800.7 feet; at Passy, 1923.7 feet: internal diameter of tube, or lining of hole, at Grenelle, approximately, 9 inches to 6 inches at bottom; at Passy, 2.4 feet. The full diameter of the Passy bore-hole was one metre, or 3.28 English feet.

The Universal Exposition of 1867, at Paris, contained fine illustrative specimens of the tools and apparatus now used by Messrs. Degousée and Ch. Laurent. In the notice of them, and of the operations of boring which follows, I have used not only my own notes, made upon the spot, but portions of the report of the United States commissioner to the Exposition.

The apparatus, doubtless, does not present, for the most part, the interest of a new invention; but in examining the details of its construction, it is easy to see that the novel and diversified condition in which the sinkings have been executed, and the unforeseen accidents which these have produced, have been studied with great care and intelligence by these able engineers, and that all the teachings of practice have been profited by and have led to many important modifications and simplifications of the forms of the tools.

The boring rods applicable to artesian wells, before the wells of Passy were sunk, did not exceed $0^{m}.30$ in diameter. The two wells undertaken by the city of Paris—one at La Chapelle, by Messrs. Degousée and Ch. Laurent, the other at La Butte-aux-Cailles, near the Ivry station, by Messrs. Dru Brothers—have been commenced at a diameter of $1^{m}.80$.

The boring apparatus comprises two essential parts—the tools which serve to excavate the earth, and the appliances at the surface for working or handling the tools, which become much more important as the diameter of the wells or shafts is increased.

The following are some of the details of the construction and dimensions of the tools used by Messrs. Degousée and Ch. Laurent at the artesian wells of La Chapelle:

The machine is worked by a horizontal steam-engine of 15 horse-power. The fly-wheel shaft makes 50 revolutions per minute. It carries, first, a pinion of $0^{m}.30$ diameter; secondly, two brakes; thirdly, two clutches; fourthly and lastly, a pulley of $1^{m}.50$ diameter.

The pinion of $0^{m}.30$ diameter drives a toothed wheel fixed on the axle of the drum of the capstan, upon which the chains for lifting the shafts of the borers are wound, and also the percussion and cleansing apparatus. The diameter of the drum of the capstan is $0^{m}.55$; its length is $1^{m}.60$. It has a spiral groove which guides the chains and causes them to wind regularly upon it. The pulley of $1^{m}.50$ diameter is belted to another pulley of $1^{m}.00$ diameter, fixed at the extremity of an axle which carries at the other end a pinion $0^{m}.40$ diameter. This pinion is geared with a wheel of $2^{m}.00$ diameter, fixed on a second axle, where is also fixed the crank-plate which, by means of a connecting rod, gives a reciprocating motion to the striking beam. This beam is supported at a point about two-thirds of its whole length distant from the connecting-rod end.

The two clutches mentioned serve, on one part, to throw into gear the pinion of $0^{m}.30$ with the driving wheel of the drum of the capstan, and, on the other part, to drive the pulley of $1^{m}.50$ diameter, keyed on the fly-wheel shaft, by which motion is given to the striking beam, at the end of which the boring tools are attached.

The two brakes placed upon the fly-wheel shaft are for the purpose of regulating the speed of the descent of the tools, the weight of which ight cause a great acceleration of speed, and, consequently a fracture, hich is always to be dreaded.

The timber framing which forms the derrick or tower for the sinking the wells is more simply arranged than that adopted by Mr. Kind in s construction for sinking large shafts. The tools, in place of being ceived upon a platform about ten metres above the surface, are upon e surface itself, and it is, consequently, much more easy to work them. he linked chain for lifting the tools has stood the wear of ten years ithout any accident; while the breaking of the cables employed in the stem of Messrs. Kind and Chaudron have occasioned serious accidents d delays.

At the boring of the wells of Passy, undertaken by Mr. Kind, there ere two machines of 25 horse-power, one of 10 horse-power working the riking beam, and one of 15 horse-power working the capstan drum. he trepan, at the shank, did not weigh more than about two tons. essrs. Degousée and Ch. Laurent used an engine of only 15 horse-power work their trepan, which weighed about four tons, and to bring the oken or bored earth to the surface. This engine did not require any pairs, except such as are ordinarily necessary during a service of two ars.

BORING TOOLS OF DEGOUSÉE AND LAURENT.

The construction of the trepan employed at the artesian well of La hapelle differs completely from that of Mr. Kind. It is composed of six anches, so arranged as to break up the earth in an annular belt or ne, leaving a central core. The six teeth, which are keyed into the ade-holder, are $0^m.35$ wide, and the mode of fixing them into the six anches is so secure and solid that, up to this date, no accident has ppened. Even when a tooth becomes unkeyed it cannot get out of e blade-holder, while at the shaft of the Hôpital there have been enty-three teeth out of their sockets, all of which fell into the shaft. ne of these accidents caused a stoppage of a month.

The percussion of the trepan with the regular rotating movement cuts t an annular channel of $0^m.45$ to $0^m.50$ large, leaving in the center of e shaft an unworked piece of earth, or core, of $0^m.80$ or $0^m.90$ diameter. his mass, when in slightly coherent earth, crumbles down and forms irregular cone. In this case they bolt on one side of the center of e tool a radial or a transverse blade, which triturates the core.

This trepan weighs about four tons. Its first cost is greater than that f Mr. Kind's, but it proves in practice to be much more solid and durale, and it works better.

Messrs. Degousée and Ch. Laurent have been very successful in givg a free fall or drop to their trepan. With more than ten thousand ows, the trepan has not once failed to be caught again upon the dent of the rods, and its fall has always worked with the greatest regurity, while at the shaft of the Hôpital eighteen fractures of pieces of e slide have occasioned a stoppage of more than a month. The conrance for the free fall of the trepan is constructed as follows: A movle piece surrounds the shaft above the hooks and terminates in a rk, of which the two branches extend below the cutters and touch the ttom of the bore. This piece is not lifted, unless the borer is raised re than the stroke allowed by the collar which attaches around the oks. The upper part of the hooks lifted by the boring rod slides, refore, in the collar, and, meeting a striker which makes them open, tool immediately falls with all its weight on the bottom of the bore.

The boring rod, being lowered, catches the tool again by the hooks, this action is repeated so as to obtain a succession of blows.

The suspension rods employed by Messrs. Degousée and Ch. Lau are of iron. They have a section of $0^m.045$ square, and are $12^m.00$ l These rods have worked for two years without accident, and they are ter than those made of wood, for the following reasons: It is evident t wood at a great depth will acquire from the pressure of the water a den at least equal to that of the water; and, moreover, the iron fittings ad the weight in a certain proportion; and if we compare the section the shafts or wooden rods of the wells at the Hôpital with those of iro the wells of La Chapelle, it is seen that the metre in length of the weighs at least 35 kilograms, (70 pounds,) while that of the second d not exceed 16 kilograms, (32 pounds.) It is true that, as the woo rods displace a greater quantity of water, their weight is diminish but this small advantage is largely overbalanced by their rapid det oration, whether in store or at work. The wood in drying heats loses its qualities. Well made, their construction appears sufficie costly to make the matter of renewing them at each sinking rathe important item; they augment sensibly the cost of work to be d On the other hand, the iron shafts that can be balanced, as practiced Messrs. Degousée and Laurent, require for their descent and elevat but a little more force, and with steam-engines this increase of expe is so little that it may be disregarded.

The draining and cleaning tools of the wells at La Chapelle di equally from those of Mr. Kind, and they are, perhaps, superior. modification of the trepan intended to work out the annular groov zone led to a modification of the auger, which is annular and comp of nine augers joined together, of $0^m.35$ diameter.

The spoon or bucket which lifts the detritus in the middle of the w is a cylinder $1^m.00$ in diameter, and $2^m.50$ in height. The bottom place of carrying two valves, is pierced with seven round holes, wl are closed by hemispherical hollow valves, carrying in their axis a s which traverses the whole length of the spoon. This shaft is termina by a handle which permits the workmen to lift up the valve in orde empty out the mud when the bucket is withdrawn from the well. arrangement is intended to obviate the inconvenience of the hin valves, which often, by not completely closing, let the matter in bucket escape during the ascent of the dredge.

The bucket at La Chapelle is emptied with great ease, it being li one metre above the surface and placed on a little truck, which car it immediately under a crane placed at the side where the contents to be emptied.

The recovering tools are composed simply of the ordinary screw (*cloche à vis*,) a grapnel, and a new form of pincers, with four branc These four branches are arranged in a parallelogram, and one of t ends is fixed to a single piece bored and tapped in its center. It is to understand the part this plays: in raising or lowering the nut in screw, which is attached to the boring rods, the four branches exp or contract at will, and, resting on the bottom of the well, they s the objects which may be there.

TUBBING.

The artesian well of La Chapelle traverses the Tertiary strata of Paris basin, and penetrates the chalks and marls of the Secondary.

According to the agreement between the contractors and the city, boring is expected to be 600 metres deep before it reaches the water-bearing bed of the green sand formation. After working two years, the well has already (1867) reached a depth of 337 metres, but it has been found necessary to tub or line the shaft to avoid the caving which would inevitably happen without it.

A first column of sheet-iron lining, $1^{m}.80$ diameter, $34^{m}.50$ high, and weighing about thirty-six tons, was put in immediately below the preparatory pit, which last was lined with masonry to a distance of about six metres below the surface, where the working platform was placed.

A second column, $1^{m}.70$ diameter, 135 metres high, and weighing 11 tons, was next put in; and lastly, a third column was put down just to the chalk. This column has a height of 139 metres, its diameter $1^{m}.37$, and its weight about 110 tons.

The columns are made of sheet iron of a mean thickness of $0^{m}.02$; the height of each section being determined by the breadth of the iron plates. These plates were fastened together by rivets with countersunk heads, so that the interior and exterior surface of the lining were quite smooth.

To form one of these cylinders, *two* sheets of iron of the thickness of $0^{m}.01$ are taken and riveted together in such a manner that one of them, the inner one for example, projects slightly beyond the other, and thus forms a shoulder to which the next section above can be riveted. By this arrangement it will be seen that each column of tubbing presented the same diameter throughout its length. When the sections of the column are thus prepared, they are lowered and put together as they descend into the well.

This operation is performed in the following manner:

A wooden frame is made and supported upon a wheeled truck. This frame is composed of two strong vertical walls of a height of four or five metres, connected at their upper part by a cap or top, to which four nuts are fixed to receive four screws intended to sustain the pipe in its descent. Each of these screws is worked by two men by means of a crank and bevel gearing conveniently arranged.

The lower part of these four screws is fixed to a strong circular wooden plate, about $0^{m}.50$ thick, and equal in diameter to the inner diameter of the column that is to be lowered.

Upon the working platform a species of tubbing in wood is placed, the interior diameter of which is equal to the exterior of the iron tubbing or cylinder. The height of this tubbing is two metres; the segments of which it is composed are united together, and can be drawn together or expanded by means of screws, so as to squeeze the column and act as a clamp or support during its descent. When this kind of tubbing is put in place, and the frame which carries the screws is put in the axis of the well, the first section of pipe is brought forward and placed over the well. Previously several iron ears are bolted upon the interior face of the tub, and about a metre below its upper edge, the use of which will be presently explained. Other projecting ears are fixed in the inside of the tub, and on these ears the lower part of the wooden plate is allowed to rest, and is then bolted to them. When the work is thus prepared, this first tub is lowered until the outer ears rest upon the upper edge of the wooden tubbing which surrounds the column on the outside. The inside ears are then removed and the pipe is supported upon the outer tub. The inner plate of wood is then lifted up by the aid of the screws, and the rivet holes of the ears are closed up by hot rivets with countersunk heads. The second cylinder is then placed in the axis of the well. This second cylinder has inside and outside ears like the first, and the circular plate is introduced and bolted to the ears. These hold it at its upper part, and it is then lowered regularly, with the aid of the screws, until the lower part fits into the first cylinder. The two sections are then riveted together by hot rivets. The tub is then lifted a little in order to remove the outside ears of the first section of the cylinder, and the whole is allowed to descend by its own weight till the outer ears of the top cylinder rest in their turn upon the upper part of the wooden tubbing. They proceed in the same way for all the other sections of the column or tubbing of the well until it is finished.

The lowering screws are each calculated to withstand a strain of fifty tons; but to prevent a too rapid descent of the lining when it has attained a considerable weight, Messrs. Degousée and Ch. Laurent make use of the species of tubbing upon the surface of the working pits already noticed. This tubbing not only serves to guide the column and to make it descend vertically, but also, and above all, to act as a powerful brake, and thus enable the workmen to control the velocity of the descent at will.

Tightening the segment screws gives a strong compression and friction over a height of two metres, sufficient to control the descent of the tubbing.

The three columns of sheet-iron lining, which have been mentioned, were put in place by this system of operating with the greatest ease, at the rate of four metres a day, including the time spent in riveting the sections of the tubbing.

When the artesian well of La Chapelle is sunk to the depth of 600 metres, a tub in one column will be lowered to the same depth. Messrs. Degousée and Ch. Laurent propose to employ the same method of lowering, and there is no doubt that these able engineers will succeed completely in this magnificent work.

The false bottom for the tubbing, which is used by Messrs. Kind and Chaudron, would not answer in this case, because it would prevent the water from rising in the well. The work carried forward at La Chapelle proves that by the system *à niveau plein*, of sinking from the surface, large shafts for mines can be executed by the tools and method of Messrs. Degousée and Ch. Laurent with great success in similar formations.

At the well bored by the Messrs. Dru, the depth at the end of April, 1867, was nearly 500 feet. The weight of the boring tool was over 2 tons 18 cwt. The rods were, for the most part, of wood, with iron connections, and 10 metres long; two rods, or a length of 20^{m}, were raised and lowered together.

BORING FOR COAL.

One great use of boring apparatus abroad is, to ascertain the thickness and nature of the strata that over-lie coal beds, and thus to know the position of the coal and the probable difficulties and expense of sinking shafts to reach the beds. It is also employed to ascertain the nature of the faults and dislocations of the beds; the extent of ancient pits and workings, and to drain such places by piercing to them in advance of the new galleries. In the coal district at Zwickau, Saxony, mining concessions are not granted until coal has been discovered by a bore hole or other means. The Brückenberg company prospected their ground by boring to a depth of 363 fms. before they found coal. The following are the dimensions of the hole in Saxon measure:

	Diameter.
1st 24 feet	6 feet.
265 feet	20 inches.
180 feet	18½ inches.

	Diameter.
315 feet	17⅛ inches.
440 feet	15¾ inches.
360 feet	14¼ inches.
250 feet	12⅘ inches.
122 feet	11⅓ inches.
198 feet	10 inches.
73 feet	8½ inches.
47 feet	7 inches.
50 feet	6 inches.

For many such operations, the diamond drill, already fully discussed, may be found superior to the apparatus ordinarily employed.

BORING FOR OIL.

The discovery of petroleum in quantities in Western Pennsylvania, West Virginia, Ohio, Canada, and other localities, has given a great development to the art of well-boring in the United States. The cumbrous pole-tools have been rejected, and the cable, upon the ancient Chinese system, substituted.

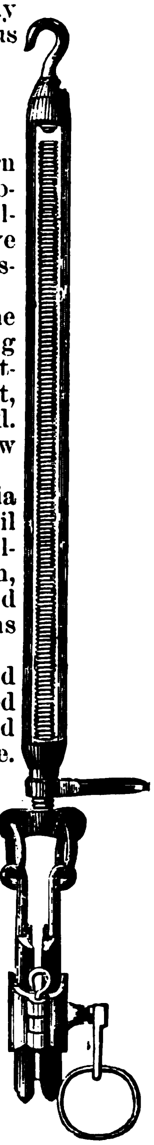
The great advance has been in the construction of the tools, and in the adoption of simple apparatus for giving motion to the drill by means of steam-power. For prospecting and for sinking to moderate depths of 50 to 150 feet, the spring-pole, worked by hand, is frequently employed. This was the apparatus chiefly used in California a few years since, when the oil regions were prospected.

The constructions in common use in Pennsylvania at the oil-wells, and used for a time during the oil excitement in California, consists of a derrick, bull-wheel, band-wheel, sansom-post, and walking-beam, and a portable steam-engine. The descriptions and dimensions given below represent the average as determined by experience.

The derricks are usually constructed of plank and boards, when they can be obtained, or of unhewed poles. They rise to a height of 50 to 60 feet, and taper upward from a base about 15 feet square. The standards are of two-inch plank, 8 inches wide, and the cross-braces 8 inches wide and 1 inch thick. The tools are suspended by the cable, which, passing over the pully at the top, descends at the side, and is wound upon the drum of the bull-wheel, the shaft of which rest on bearings in the standards. The drum of the bull-wheel is about 10 inches in diameter.

The walking-beam, of wood, 26 feet long, is supported at the center upon the top of the sansom-post. One end is connected by a pitman, with a crank of 22 inches radius, upon the end of a shaft receiving motion by a belt from the engine; the other end, projecting within the derrick and directly over the well, carries, suspended, the tem-

Rope Socket.



Temper Screw.

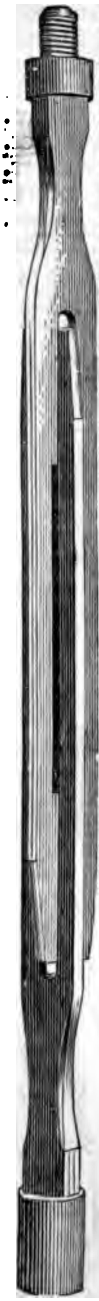
per-screw, to which is attached a clamp for seizing upon the rope. The rotation of the crank-shaft gives a reciprocating motion to the end of the beam, and this is imparted to the rope, carrying the tools at its lower end.

The form of the temper-screw is shown by the figure. By this the drill may be lowered or "fed out" to a certain extent during the progress of boring. The rope is seized and held fast by the clamp; and when the whole length of the screw is fed out the position of the clamp is changed.

The drilling tools consist of center-bits, reamers, an auger-stem, sinker-bar, and the "jar," besides a socket for attaching them to the lower end of the rope, and wrenches, and other accessories to aid in attaching and unscrewing the bits. There are, besides, a variety of tools for recovering broken bits or other parts of the apparatus lost in the well, and sand pumps for removing the débris.

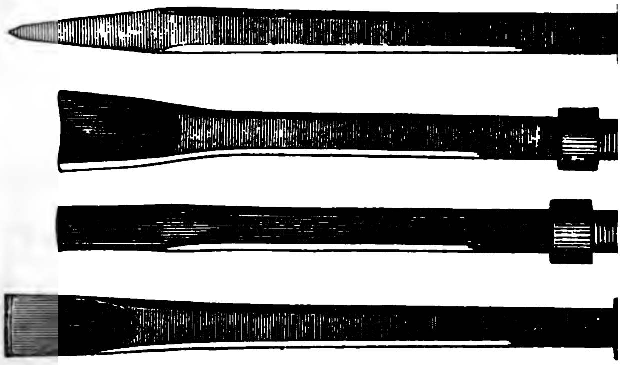
The bits are represented by the annexed cuts. They are $3\frac{1}{2}$ inches broad on the face, and the reamers are $4\frac{1}{2}$ inches. They are made, however, of various sizes, and all have strong square shanks, so that they may be firmly screwed into the auger-stem, made of $2\frac{1}{4}$ inch iron and 20 feet long.

The "jar" is a contrivance by which the auger-stem and bit is, in a measure, detached from the rope. By it a blow or sudden jerk may be given upwards so as to loosen the bit in case it becomes wedged in the hole,
same device serves to give a blow downward upon
after the bit strikes the bottom, thus doubling the ef
each stroke. It serves also to maintain the tension of the ro
the stroke. These jars are made of $1\frac{1}{4}$-inch iron on the sides
inch heads, and 18-inch stroke.



The Jar.

The W



Bits and Reamer for drilling.

The sinker-bar, 10 feet long, is attached by a screw to the r, and above this is the rope-socket, securely united by means to the end of the rope.

ts and other parts of the drilling tools are connected and sted by means of two large wrenches, 3 feet 9 inches h broad flat heads, shaped as shown in the figures.

rilling ropes or cables vary from 1¼ inch to 1¾ inch liameter, and weigh from 48 pounds to 86 pounds per .00 feet.

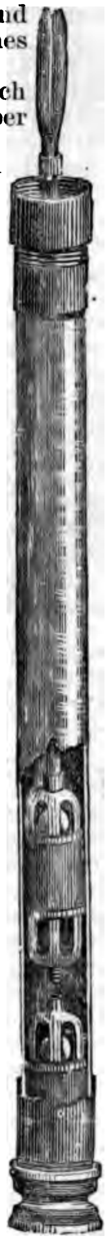
The sand pumps made of heavy sheet-iron, or of galvanized iron, sometimes of copper; are ibout 5 feet long, and from 3 inches to 4 nches in diameter, and are fitted with leather valves resting upon iron seats, as indicated at the lower end of the figure.

These tools, and the iron fittings for the valking-beam, wheels, and other parts of he apparatus for well-boring, are manufactured by Messrs. Hart, Ball & Hart, of Buffalo, New York, to whom I am indebted for he illustrations. The steam-engines in use ire portable, and generally from 8 to 10 iorse-power. A 900-foot well can be drilled with an 8 horse-power engine. Rope for a well 900 feet deep, with the tools, will weigh ibout 800 pounds.

Before commencing to drill it is usual to lrive down a cast-iron pipe through the oose soil and alluvial deposits until the firm bed-rock is reached. These pipes are made in lengths of eight feet, and are from five to six inches in diameter. They are oined together, end to end, by means of wrought-iron bands carefully welded and sized to shrink on to a shoulder turned upon each end of the pipe in a lathe, so that a flush joint is formed by the band. The lower end is made sharp, and the band is edged with steel. This form of joint has been patented by Mr. Bolles, whose name it bears, and it gives great satisfaction. The five-inch lengths weigh 55 pounds per foot, or 440 pounds in all; and the six-inch 69 pounds per foot, or 552 pounds per length.

For lining the wells wrought-iron tubing is used, made with screws and sockets or with flush joints, but always smooth-finished inside. The sizes vary. For the light kinds, from one and a half to four inches for the inside diameter, and from 1.66 pound to 6 pounds per foot. The heavier tubing ranges from one and a half inches in diameter, and 2.70 pounds per foot, to 6 inches, weighing 18.7 pounds per foot. rge sizes are seldom used for oil wells.

Stuffing Box.



Oil Pump.

s are made of wrought-iron pipe lined with heavy seamless brass red perfectly true, or of heavy brass tube alone. One of the tioned construction, five feet long, is shown by the annexed figure, in which a portion of the interior is seen with the two valves and boxes. These valves are made of gun-metal, and are fitted with great care. The packing is made of the best oak-tanned leather. Ball valves are generally used. The pump here represented is manufactured by the Messrs. Hart, and they have made an improvement upon the ordinary construction, by which the lower ball valve may be loosened from the top of the guard over the valve seat, to which it sometimes becomes attached by the accumulation of a deposit. A projecting point at the bottom of the upper box enters the hole in the top of the lower box, and thus forces down the ball. The portion of this projection nearest to the box has a screw thread cut upon it, and may be screwed into the box below, so that they may both be drawn out together. The pump barrels are usually five feet in length.

At the top of the well a stuffing box and elbow pipe is fitted. The construction of this box and the form of the joint for attaching to the sucker rods is shown in the figure. The stuffing is kept in place and is pressed firmly upon the plunger-rod or piston by means of the follower, made of brass. The plunger-rods are five feet long, are made of one-inch diameter cold-rolled iron, and are perfectly polished.

One other important adjunct of a complete oil well is the seed-bag, the use of which is to form a water-tight joint or packing around the tube or lining of the well, and thus shut off all communication between the water of the upper strata and the oil-bearing crevices or chambers below.

This bag is made of leather, and is filled with flax-seed. It is put around the tube and is pushed down to the proper place, and soon becomes so much swollen by the absorption of water, that it fills the space between the tube and the walls perfectly, and shuts off all communication around the tubing for either water or oil from above or below.

THE AMERICAN TUBULAR WELL.

A very expeditious and simple apparatus for obtaining water, where it is not at very great depths below the surface, and in alluvial soil, is here worthy of mention. It is known as the tubular pump, or tubular well, and consists merely of a wrought-iron tube an inch or two in diameter, which forms the pump barrel. This is fitted with a valve near the bottom, and tipped at the end by a sharp-pointed steel plug. This sharp point permits the whole tube to be driven down into the soil until the watery ground is reached, when, by raising the pipe a few inches, the plug is detached, and the lower end of the pipe is left open, while at the same time, a small water chamber is formed. By inserting a pump-rod, with a lift-box, water may be pumped to the surface in a continuous stream.

This simple pump has worked well in sandy and gravelly soils, and is said to have been of great service to the British forces in Abyssinia. It could doubtless be used to great advantage in many places throughout the Great Basin and in California.

CHAPTER LXIX.

BORING LARGE MINING SHAFTS.

The methods of boring shafts of large diameter have of late years been carried to great perfection abroad, especially in France and Belgium, and there is little doubt that they might be introduced with advantage in some sections of the western coal-fields; and perhaps, also, in the metalliferous regions among the harder metamorphic rocks. It is therefore deemed appropriate to give a short description of these methods and of some of the great results which have been achieved.

Probably the most important advance in the art of mining, of late years, is in the sinking of large shafts by boring. Boring into the earth to great depths is no longer confined to explorations in search of water or oil, liquids which will freely flow out in quantity through small openings, but it is now resorted to for the construction of deep shafts through which solids, such as coal and metallic ores, are to be hoisted.

Even artesian borings have been increased in size until they resemble rather mining shafts than the former borings, only a few inches in diameter. The art of boring has received a great impetus from the necessity of boring larger and deeper wells for the supply of the city of Paris with water. Several wells have been commenced with a diameter of more than three feet, accounts of which were given in a former chapter.

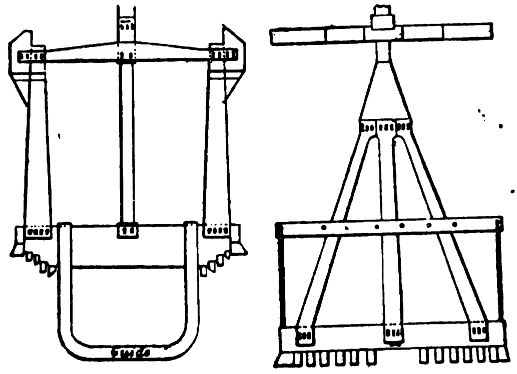
In order to bore shafts and wells of such great diameter it is necessary to use tools of immense size, weight, and strength, and steam-power to move and work them. The great improvements are due chiefly to Messrs. Fautet, Dru, Degousée and Mulot, in France; Sello, Kind, and Oeynhausen, in Germany; Jobard, Guibal, and Chaudron, in Belgium.

The most striking feature, next to boring, of this system of shaft-sinking, is that the work is executed and the shaft is lined without pumping the water out of the excavation. The sinking proceeds under water, and the shaft is not drained or entered by miners until it is completed and lined from top to bottom.

The method thus finds the most useful application in regions where the strata to be passed through are highly charged with water, and, in fact, it owes its perfection to the necessity of penetrating through watery and difficult ground in the northern French coal-fields. The expense and extreme difficulty attending such operations in the ordinary way is well known. Burat estimates that a capital of upwards of $600,000 is expended in opening a coal mine with a productive capacity of 100,000 tons annually. Examples of a still greater outlay are not wanting. Warrington Smyth, the great British professional authority upon mining, states that, in consequence of the difficulty of piercing through the strata overlying the coal in Durham, England, sums of £40,000, £60,000, and, it is even said, £100,000, have been expended on a single shaft.

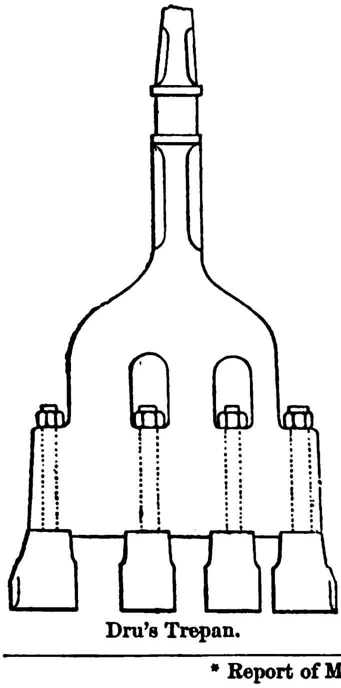
As early as 1860 M. Chaudron succeeded in sinking an air-shaft at Péronnes, where the watery beds extended from the 43d metre to 105 metres in depth; and M. de Vaux, inspector general of mines, Belgium, reported in 1861 that the work had been executed for less than one-quarter of what it would have cost if sunk in the ordinary way.

In the coal basin of Saarbruck, in the north of France, at L'Hôpital, the Saint Avold Company desired to sink two shafts, one for ventilation, and the other for extraction. There were 150 metres in thickness of water-bearing strata to be passed through. After numerous unsuccessful efforts before the year 1858, and an expenditure of more than 21,000,000 francs, about $4,200,000, the attempt to execute the work in the ordinary manner was abandoned, and recourse was had to the engineers Messrs. Kind and Chaudron, who, by the boring process *à niveau plein*, succeeded in sinking and lining the two shafts in the most satisfactory manner in less than thirty months, and at a cost of less than 700,000 francs, which includes the cost of installation and the tools—nearly one-seventh of the whole sum. The tools used in this work, and ı the cast-iron lining or tubing, were exhibited at the Expositic and have been reported upon in the series of reports by the Uni commissioners. They are also described in the reports of tl tional jury, and I am indebted for many of the figures here ş plementary to my own notes at the Exposition, to the report naert.*



Massive Trepans.

The tools consist of enormous trepans, one of which weigl than 14,000 kilogrammes, about 15 tons, so large and pond it was hardly possible to conceive of its being suspended in a made to rise anc the rocks at tl The general cons the trepans will stood from the aı ures. The mass work is armed ɛ tom with stout teeth of steel, s tached in conic and, in the most forms of the : bolted in, or s keyed that they loosened and los pit during th shocks of workin nexed figure shows the form of a full-blade trepan, (*à lame* used by Messrs. Dru Brothers, su Messrs. Mulot, in boring at the *Cailles*. One of the precedi shows the construction of a tre guide rod at the bottom, as u Kind, for enlarging holes alre by a smaller tool. This form is a detaching apparatus at the shown in the figure,) so that raised and dropped in the hol by the percussive force of the b



Dru's Trepan.

The notable example of bo shafts by the method indicate already mentioned, the construc shafts in the department of tl France, at L'Hôpital, for the Company. Two borings were ı for an air-shaft (No. 1) with a d $1^m.80$ within the tubbing, and 2 greatest diameter; the other for a winding or hoisting shaft with a diameter of $4^m.10$, and when finished. The operations, to this method, succeed in the order:

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* Report of M. Gernaert in the jury reports.

Construction upon the surface—buildings and derricks.
Boring the pits.
Lowering the tubbing.
Puddling or packing.
Packing at the base of the tubbing.

Surface preparations.—The preliminary operations consisted in the truction of the necessary buildings for the engines and tools, and rection of a derrick over the site of the pit. All these were of tem- ry construction, intended to be used merely during the progress of ork.

e derrick was made of four supports strongly framed together, and ining a platform about thirty feet above the surface of the ground. this a railway or tram-road was laid for the trucks, which carried oring tools and rods.

e engines for sinking comprised the *capstan*, the *jumper*, and the *y-engine.* The capstan was used for lowering and hoisting the g tools in the pits, and for lowering the tubbing or lining of the . The engines had a nominal force of 25 horse-power. The diam- f the cylinder was 0m.56, and the length of the stroke 0m.70. The ctive diameters of the gearing were 1m.70 and 0m.35. Admitting an ive pressure of three atmospheres, the initial force upon the driv- haft was 48,513 kilogrammes.

e first rope used at the air-shaft had a section of 54 square centime- capable of sustaining a strain of 5,400 kilogrammes. It was made of hemp; but after working for one year, it broke in lifting a trepan hing 3,858 kilogrammes. The tool fell from a height of 86 metres, g with it 17 metres of the rope. This accident occasioned a stop- of nine days. The cable was replaced by another having a section square centimetres, and after using it for fourteen months the was suspended for three days in order to make a new splice.

e second machine—the jumper—was made of an engine cylinder, at the bottom and closed at the top. The piston-rod was connected tly with the wooden beam, carrying the tool for cutting and boring other end. By the alternate lifting and falling of this tool with ttached beam, the rock was cut away. The diameter of the piston e jumper was 0m.60, and the greatest length of stroke was one e. The jumper did not require any repairs during the whole opera- of sinking the shaft.

e third machine—the donkey-engine—was used to work a pump for nd for cold water. It is indispensable for the supply of the boiler, e capstan and the jumper work irregularly. Experience has shown the feed-pumps should be in duplicate, so as to avoid the necessity opping for repairs.

e preparations for sinking the air-shaft were commenced in October, , and were finished in the following month of April. The expense as follows:

	Francs.
dings	28,302.65
hines and tools	37,326.91
Total	65,629.56

oring the pits.—Before commencing the sinking with the special s, a preparatory pit was sunk to a depth of 21m.40, and was lined masonry to a diameter of 2m.80 up to within 5 metres of the surface, where the diameter was increased to 4 metres. This shoulder in the stone lining afforded a foundation for a platform.

The sinking was accomplished by two different operations. First, a central pit of 1m.37 was sunk and then enlarged to 2m.26. The débris of this enlargement fell into the first pit. The tubbing was inserted in the enlarged pit.

The boring tools employed in these operations will now be described: the scraper, the scrape-hook, and other apparatus was used indiscriminately in the two pits.

The little trepan first employed weighed 2,085 kilogrammes, and was formed of two principal parts—the fork and the blade. The blade was 1m.26 long, and had teeth of cast-steel, or of iron faced with steel. These teeth increased the diameter of the trepan to 1m.37. The blade was joined by means of keys to two strong iron arms, which were united above with a central shaft, which was connected by a slide with the suspension apparatus.

This trepan worked easily through the sandstone of the Vosges—*grès des Vosges*. The fall given was 0m.30. The progress per day was at first 0m.79, and it diminished to 0m.52, and then to 0m.28 at a depth of 121 metres; but at 135 metres in depth, in a stratum of strongly aggregated silicious red sandstone, the progress was only 0m.15 and 0m.11. It was soon found that this trepan was too light to stand the shocks of the blows, and three successive ruptures of the stem made it necessary to procure a stronger trepan, weighing 3,858 kilogrammes, divided among the various parts, as follows:

	Kilos.
Body of trepan	2,700
Guide	340
Blade	230
Four teeth of the head	148
Four intermediate teeth	88
Plates and keys	352
Total weight	3,858

The teeth are fixed upon this mass of iron by means of keys. The sockets for the reception of the tenons are conical, and are 0m.10 in diameter at the base and 0m.09 at the top. The progress in the work made by this trepan, from the commencement, was from 0m.28 to 0m.32, and even as high as 0m.83, giving a mean of 0m.39, being three times as much as made by the first trepan. This shows clearly that the heavy trepans are best for the hard strata.

The trepan which was first used for the enlargement of the pit to the diameter of 2m.56 had a blade 2m.46 in length; it was formed like the little trepan first used, and had a blade fixed upon a fork, and weighed in all 3,980 kilogrammes, divided as follows:

	Kilos.
Fork	2,500
Blade	906
Six teeth of the head	103
Three intermediate teeth	48
Two plates	430
Total weight	3,980

order to avoid the frequent breaking out of the teeth, this trepan ifted only 0^m.20. The progress made with it daily was from 1^m.10 .18 at the last, when a stratum of hard sandstone was encountered he weight of the trepan was found to be insufficient. Two blades, bove the other, were then united to the fork by rings and bolts. of these blades carried the teeth so as to cut the strata in two . This new tool weighed about 5,000 kilogrammes. It worked nonths, and required frequent repairs. The rate of progress per ras only 0^m.11. It was then decided to replace this trepan by a massive one, weighing 8,000 kilogrammes, and 2^m.50 in diameter. this the progress was increased to 0^m.34 a day, thus showing a d time that in hard rock heavy trepans are required.

diameter of the pit at the beginning was 2^m.56; at 134^m depth it educed to 2^m.45; at 155^m depth it was reduced to 2^m.40; from 155^m.00 5^m.50 depth it was reduced to 2^m.33; from 155^m.50 to 158^m.00 depth s reduced to 2^m.25. At this depth the little pit was continued for a of seven metres, and a circular curb of 0^m.40 was fixed to receive ase of the tubbing.

work of sinking this air-shaft lasted about twenty-eight months half. The central pit required 392 days, including 46 days during ı work was stopped, so that only 346 of actual work were necessary. nlarging operations to a diameter of 2^m.56 occupied 469 days, in- ıg 148½ days of no work. The depth of the central pit being 0, (equal to 471.46 feet,) the mean progress for each working day ^{m}.15, (13 feet,) and the enlarging to 2^m.40 gave a daily mean of for a depth of 136^m.60.

expenses of boring were as follows:

	Francs.
es and wages..................................	55,039.81
....	12,513.11
ıd grease.....................................	2,381.71
....	2,987.20
steel, and repairs to tools........................	12,530.90
ge and sundries..............................	7,560.66
Total..	93,013.39

ıBING.—Before entering upon a description of the operation of ıg the air-shaft, it will be best to explain the system adopted by s. Kind and Chaudron.

tubbing of the pits is accomplished by lowering into them a me- cylinder, which finally rests upon a proper seat or foundation, lly cut for it at the bottom. This cylinder is made smaller than re of the pits, and the space between the cylinder and the walls is ard puddled or filled in with concrete, so as to make a solid con- ıs lining. The metallic cylinder or tubbing is formed in sections ylinder, made of cast iron, and provided with flanges projecting l, by which they are securely bolted together. One section or is added after another to the top as the whole descends in the that at the completion of the work the whole pit is lined with om the top to the bottom. The outer surface of all these sections cylinder is quite smooth; but in the inside, besides the flanges bolts, there are horizontal ribs or webs cast with each segment, tended to strengthen them.

thickness of the tubbing will evidently vary with the diameter of the pits and that of the different segments, according to their position in the pit. Messrs. Kind and Chaudron determine the thickness by the following formula:

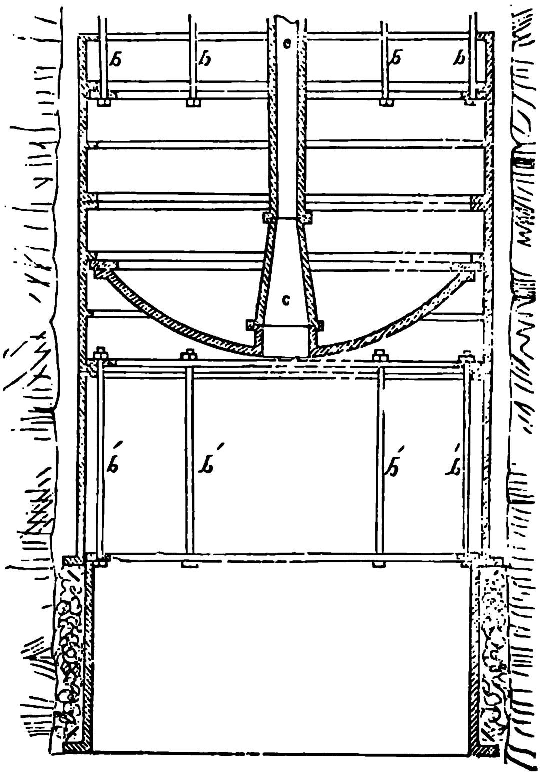
$$E = 0^{m}.02 \times \frac{R \times P}{500}.$$

E represents the thickness of the tub, R the radius, and P the pressure expressed in kilogrammes upon the square.

M. Gernaert, of the International Jury of the Paris Exposition, says that the principal merit of the success at L'Hôpital should be given to the inventors of the method of lining the shafts while full of water. The jury awarded the highest order of prizes under the title of co-operators to the engineer, M. Kind, of the kingdom of Saxony, and to M. Chaudron, of the mining corps of Belgium, particularly for the improvements in lining or tubbing, which form an indispensable complement to the process of boring shafts in watery strata, and without which the perforations, however large, would not have any great practical value.

The operation of boring was not new. Many engineers had succeeded in excavating shafts of large diameter in this manner, but the great difficulty was to secure a firm and water-tight lining for them. M. Kind had proposed to lower tubbings made of wooden staves held by metal hoops. Many shafts were lined in this way, but all or nearly all were failures. A shaft was finished in this manner at Dalbuch, in Westphalia; but when the water was pumped out, down to a certain level the pressure displaced the staves and it became necessary to insert very heavy iron rings throughout the whole extent of the tubbing. But notwithstanding these expensive efforts the quantity of water which forced its way through the vertical joints was sufficient to supply a powerful pump.

Cast-iron tubbing made in segments of a cylinder and bolted together was next employed; but even these, notwithstanding the great care used in fitting and placing them, allowed water to penetrate, especially along the vertical joints. But at L'Hôpital, M. Chaudron avoided these difficulties by casting sections of the cylindrical tubbing in one piece. These sections were made about $1^{m}.50$ high and $3^{m}.40$ in diameter and varied in thickness from $0^{m}.060$ to $0^{m}.028$, but were strengthened by ribs and flanges on the inside, which served also for bolting one section to another.



Cylinder and Moss Box.

opposing faces of these cylindrical sections were truly turned or ned down at right angles with the axis, so that they fitted accurately upon another. The joint was made more perfect and tight by a king of heavy sheet lead.

he shaft having been bored to the proper depth through the watery und, and a firm seat or socket secured at the bottom in solid and paratively impermeable rock, the next operation was to lower the t-iron tubbing to its place. This was accomplished in the most in- ious manner by M. Chaudron, by tightly closing the bottom segment he cylinder with a hemispherical cap, so secured that it could be rward removed, and then floating the cylinder in the water of the

But in order to secure the descent as section after section was ed at the top a central open column or tube *e e* was bolted to the bot- , and through this, by means of holes drilled at proper distances, er was allowed to enter the inside of the cylinder for the purpose of ing it, and to aid in keeping it in a vertical position. The annexed dcut shows, in section, the cylinder, the convex bottom, the central quilibrium column, the moss-box, and the suspending rods *b b* and *b'*

The moss-box is a contrivance similar in its objects and application he seed-bag used by the borers of petroleum wells to cut off the in- s of water from strata around the pipe. By means of the moss, nded laterally when the cylindrical column of cast-iron tubbing is wed to rest upon it, a tight joint is formed between the firm rock at bottom and the cast-iron tubbing, thus effectually shutting out the er.

he entire cost of sinking the first shaft (or shaft No. 1) at L'Hôpital ugh the watery strata to a depth of 140 metres, the internal diam- eing $1^{m}.80$, amounted to 255,041.27 francs, divided thus:

	Francs.
liminary works	65,629.56
king the pit	93,013.39
bing	78,577.53
creting	11,811.20
king	6,009.59
Total	255,041.27

hich gives an expense of 1,600 francs per running metre.

he cost of shaft No. 2 is estimated as follows:

	Francs.
liminary works	104,571.77
ing the shaft	141,659.31
ing	169,220.07
creting	15,000,00
king	10,000.00
Total	440,451.15

t the rate of 3,100 francs per running metre.

he preliminary work commenced in September, 1863, and on the 6th pril the concreting was finished; the work lasted three years and a

CHAPTER LXX.

MACHINES FOR CUTTING OUT COAL.

Before proceeding to throw down coal from its place in the bed it is necessary to undercut it, that is, to excavate a space at the floor of the seam, partly in the floor and partly in the coal, thus undermining the coal so that its gravity assists in bringing it down. This undercutting operation is known as holing, baring, kirving or undercutting, and is one of the most laborious and difficult duties which the miner is called upon to perform. It is often effected under the greatest disadvantages, especially when the seam of coal is very thin, and is cut on the end, to improve its salable qualities. The work is usually accomplished by means of a pick in the hands of a miner, while he rests extended upon his side. An experienced miner makes about forty blows a minute with a pick and cuts from three to four feet under the coal, at the rate of one to one and a half linear yards per hour. In order that the miner may have the necessary space for his body in working so far under the coal, much of the coal has to be cut away and destroyed. It is estimated that the miner under such circumstances exerts about one-sixth of a horse-power, which is applied percussively. He works into the coal as a mechanic with a hammer and cold-chisel used to cut away iron before planing and slotting machines were invented. The proposition to substitute machines for manual labor in cutting out coal was made some twenty years ago, by Mr. Peace, of Wigan. He invented a machine called the iron-man, but it met with ridicule and contempt. Much attention has of late been given to the construction of machines for the purpose, and a very considerable degree of success has been attained; but it cannot be said that any of the machines yet put into operation give entire satisfaction under all conditions. Most of the efforts in this direction have been made in England, where several machines have been brought prominently before the public by means of descriptions and advertising, and by the exhibition of the machines or models at the Paris Exposition of 1867.

The following observations upon the value and importance of machines for excavating coal are taken from the Colliery Guardian, November, 1869:

> How to win and work coal most economically, is a problem the satisfactory solution of which is of the highest moment to the colliery owner, the mining engineer, and the public at large. In this matter producers and consumers are alike interested. and the question is one the growing importance of which is becoming daily more evident. In these times of keen competition, the most successful man in any branch of industry will generally be the one who has at his command the most efficient appliances in the way of improved machinery and skillful modes of operation. To this rule—applicable to trade and manufacture generally—coal-mining is no exception. A saving of a very insignificant amount—say but a few farthings—per ton, upon the whole of the out-put of a large colliery, will make a marvelous difference in the financial prosperity of the concern, and will present a very satisfactory result in the profit and loss account. To this fact colliery owners and managers are fully alive. Hence, in the meetings of the North of England Institute of Mining Engineers, and other kindred associations established in the several mining districts of Great Britain, attention is perpetually directed to this one point, and a patient and painstaking examination is given to every proposal, the professed object of which is to facilitate any of the numerous operations connected with mining industry. Any improvement in boring or sinking—in coal-getting or underground conveyance—in winding or shipping the produce of the mine, need only be fairly brought under the notice of the mining community to insure for it careful consideration and impartial judgment. Special attention has of late years been directed to the subject of coal-getting by machinery. More than a century has elapsed since the first apparatus designed for the effecting this object was patented and since that time "iron men" and coal-getters in great numbers, and almost equally

eat variety, have been presented to the mining public. Additional impetus was ren to inventive genius by the appointment of a committee of the North of Eng- d Institute, commissioned to investigate the subject, and to report upon the value existing patents; by the prizes offered by the South Lancashire and Cheshire Coal sociation for the best coal-cutting machine; and by the encouragement afforded by ning engineers, both in their individual capacity and when incorporated into asso- tions. It was felt that, looking at the success which in other departments of indus- has attended the substitution of machinery for hand labor, there was good ground the belief that machinery might also be advantageously applied to the cutting of uniform a substance as coal, and the driving of airways through it. The purely chanical operation of cutting, by means of a light pick, a groove of from 2½ feet to eet deep along the face of coal which is to be removed, is not only slow and labor- s, but also wasteful, inasmuch as a considerable amount of the seam is necessarily t into slack; and forming, as this process does, the chief item of expense in the ex- ration of coal, it has of late been more seriously forced upon the attention of coal ners by the irregularities and strikes of the workmen, which have so often brought operations of coal mines to a ruinous stand-still. The introduction of efficient ma- nery is also calculated to have an important bearing on the safety of mines, enabling m to be more rapidly opened out, and the seam to be intersected or the winning to surrounded by air-ways so as to drain off the dangerous gases. It is not to be won- ed at, therefore, either that an efficient machine for getting coal should have become acknowledged want, or that so many ingenious inventors should have applied them- es to the production of apparatus to meet that want. It is true that many of the entions have been crude, and some of them designed without much regard to some the first requisites to extended application, but others have been tested in actual king, and found to give satisfactory results.

Machines for coal-cutting may be classed under two distinct types, ng, like the machines for rock-drilling, made upon two very different nciples. One type is percussive, and imitates the cutting operation the pick as swung by the miner; the other concentrates and applies power continuously through cutters which are pressed against the d and shave it off little by little. Prominent among the machines of second type is that of Carret, Marshall & Co., of Leeds, England.

CARRET, MARSHALL & COMPANY'S COAL CUTTING MACHINE.

This machine works like a hand-plane; and it is claimed that it has power of eighteen men, that it can work effectively in a space only o feet high, and cut into coal as a scoop cuts into cheese, accomplish- more in one minute than 700 blows from a pick can in the same time. It is about two feet high, weighs one ton, has four legs of adjustable gth, and is provided with a holding piece adjusted so as to touch the f of the drift and hold the machine firmly to its work. The motor water, under a pressure of about 20 atmospheres or 300 pounds, and plied through a 2-inch pipe at the rate of 30 gallons per minute.

This water pressure acts vertically on a 5-inch piston pressing against roof, and horizontally on one about the same size, reciprocating 18 hes and 15 to 20 times in a minute. There is a pressure of 5,000 nds against roof, and the same pressure acting horizontally, forcing ee steel cutters shaped like cheese scoops into the coal. These cut- g tools are 3 inches wide, and penetrate 4 feet, with a power equal to orses or 18 men; and this is effected by a consumption of 50 pounds coal per hour to feed the boiler of the engine, which makes the water ssure, and pumps the same over and over again.

The construction in detail is shown by the figures,* which embrace a t elevation, a ground plan, and an end view, all drawn to a scale of ee quarters of one inch to one foot, or one-sixteenth the real size.

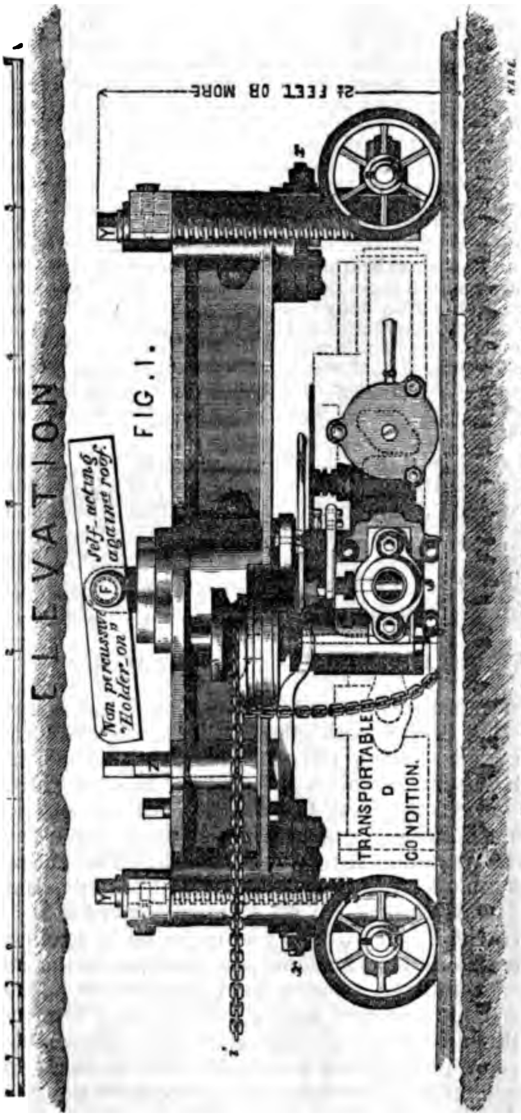
The machine in operation fixes itself dead fast upon the rails during cutting stroke, and releases itself at the back or return stroke, and verses forward the requisite amount for the next cut without any manual labor. Should the tools be prevented making the full str one cut, they will continue to make more strokes at the same until the maximum depth is attained, when, the machine will m self forward the re amount for the ne Thus, at *one opera* uniform straight d attained, parallel w rails, inducing ar fracture when the are brought dow thereby a straight l the new coal face. is no percussive either against the into the coal, but a concentrated pr producing a stead rocating motion at strokes per minute. is, consequently, n or noise, and littl and tear.

---

* Supplied for this report by Messrs. Carrett, Marshall & Co., the manufacturers.

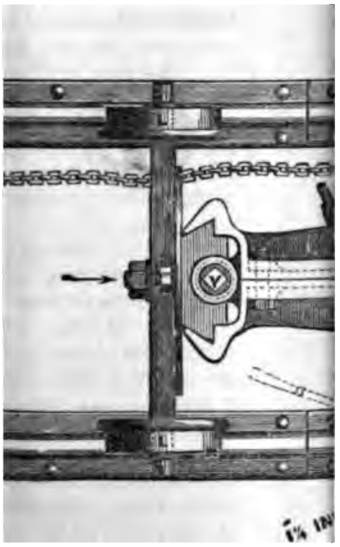
For the same when cutting pyrit tools throw out no and the workman c any movement in t or roof.

The required from the line of r the "holing," "ki or "baring," var different mines, it that the hydraulic c cylinder, and its action cutting tool sometimes to be ar *above* the carriag sometimes *beneat* main carriage, or down upon the ra is illustrated in the tions. The first fi the main carriage four wheels far e apart to allow th chine to be placed longitudinally when being transported from to place. The screws YY are for raising and lowering the ca and its cylinder and cutting tools. The pinion Z and the seg rack H regulate the desired angle of the tools cutting into th face, and the two nuts *xx* at each end of carriage regulate the required, when necessary that it shall not be in the same plane rails.


ELEVATION
FIG. 1.
2½ FEET OR MORE
Self-acting against roof.
Non percussive "Holder-on"
TRANSPORTABLE D CONDITION.
F
Y
Y
Z
H

Carrett, Marshall & Co.'s Coal Cutter, front elevation.

AAA are the cutting tools, B the cutter bar, N a guide roller f same; D is the main cylinder, with its self-acting hydraulic val



CARRE

[illegible]

ich passes a portion of its water alternately above and below
n of the holder-on, which thus rises and falls without percus-
d follows the un-
e of the roof of
, so that the re-
l stability is giv-
machine for the
ing, an instant
he cutters enter
.
holder-on piece"
ny length neces-
ridge over gaps
of; it is loose on
F and droops at
ng end to enable
e over the vary-
ections in roof.
averse motion is
l by the pin *b*,
onnects the cut-
with piston rod,
e termination of
d of its stroke
the lever *d* in
rections, which
on the pawl *e*,
auses the chain
revolve on the
made fast ahead
anchor-prop be-
oor and roof.
ugh the length
e of each cutting
eighteen inches,
actical cutting
s sixteen inches,
nsequently, the
tters jointly give
ffective depth of
t at each stroke
nachine, finish-
work as it goes
The mechanism
d consists of a
ic reciprocating
adjustable to any
nd angle, having
cting valve mo-
The cylinder is
d a half inches
r, and lined with
and the piston
ht with ordinary
ic leathers, which can easily be renewed. Within the piston rod
ed the cutter-bar of steel, carrying the tools or cutters. These

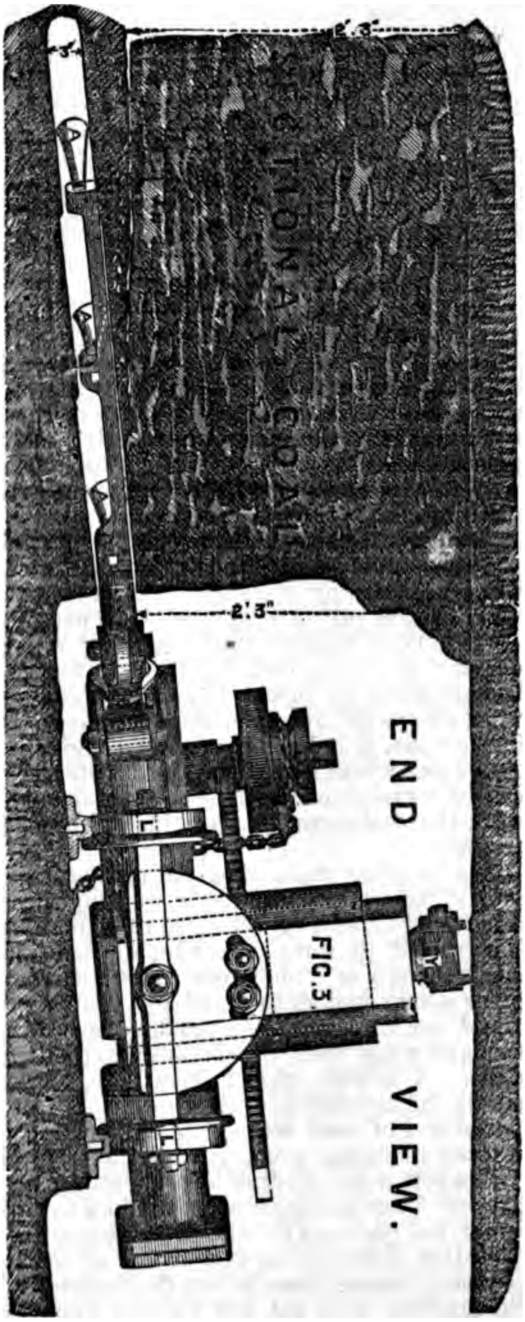


FIG. 3.

Garrett, Marshall & Co.'s Coal Cutter, end view.

can be varied in number to suit the depth to be holed at one operation. The cutting tools are of double sheer steel, can be easily made, and are very strong, and can be removed and replaced in a few moments; they can be readily sharpened on an ordinary grindstone. The cutter-bar is also moveable, when transporting the machine from place to place, for which purpose the main cylinder is, for the time being, placed longitudinally with the rails. (*See dotted lines in Fig.* 1.)

The machine is about three horse-power, and weighs one ton, and will work either right or left. (*See dotted lines on ground plan.*) It is self-acting in all movements, and will ascend steep gradients; being simple in all its parts, it is not liable to get out of order, and is easily managed by an ordinary miner, and can be transported from place to place, on the ordinary rails, about the mine,

The machine undercuts "holes," or "kirves," with a man and boy as attendants, and completes the work with once going over, at the rate of fifteen yards per hour, and at any angle and height from floor rails, being suitable for either "dip" or "rise" workings, and is capable of cutting the thinnest seams. The pressure of water which actuates this apparatus can be obtained either from the stand pipes in the pits, or from pumps attached to any existing engine, or from an engine and pumps specially made for the purpose. The quantity necessary is only what is sufficient to fill the circuit of the pipes, using it over again when desirable, as in the Bramah press.

Each machine uses thirty gallons per minute, at about 300 pounds pressure, according to the hardness of the coal or mineral to be operated upon. In cutting the shale of the Cleveland ironstone band, a somewhat greater pressure is found to be necessary.

There is no limit to the pressure of water that may be used, nor the distance it may be forced without loss of power, beyond that due to its friction along the pipes. The same water pressure is also applicable to work pumps and rotary engines for hauling, &c., and other requirements in the mine, at a distance from the engine power.

In cases where there is a fall of water, say of 100 pounds pressure, it can be "intensified" by a self-acting machine to 400 pounds pressure, to work the coal-cutter, but sacrificing three-fourths of its bulk, which is set free.

In arranging the engine and pumps required to make a "continuous stream" of water pressure for working these machines, it is preferable to have two steam cylinders, so that there be no dead center. They are constructed to work one, two, or four machines. Pipes, if for one machine, are of 2-inch bore, wrought iron, a superior quality of gas pipes strong enough to stand 500 pounds pressure, and are supplied at 3*s.* 6*d.* per yard. These pipes are screwed together in the ordinary manner, and adapt themselves readily to the irregularities of the floor of the mine. A flexible pipe 1¼-inch bore, suitable for the same pressure, allows the machine to traverse.

The cost of each self-acting coal-cutting machine as here described, without its anchor-prop, traverse chain, or pipes, is £125.

This self-acting, hydraulic, coal-cutting machine, or "iron man," which has now been two years at work, does not dispense with the labor of the miner, but performs for him the undercutting, which is a most laborious operation, either in the end or face of coal, and in a more efficient and economic manner than he can do it himself. The coal so operated on by the machine does not fall forward when becoming detached from the roof, but settles on the lower bed, thereby avoiding serious accidents. It is claimed that the saving in coal alone more than pays for the outlay;

d that it is practicable to cut with the most perfect ease into the floor the mine, thus preventing all waste of coal whatever.

The size of the coal is improved, the amount of slack is considerably luced, and a single seam, it is said, will yield more by one thousand ns of coal per acre than when worked by hand labor in the usual nner.

COAL-CUTTING MACHINE OF MESSRS. JONES AND LEVICK.

This machine may be described as a contrivance for holding and inging a miner's pick so as to undercut a coal-seam nearly as it is done hand. It is actuated by compressed air, and is mounted on a carge or truck with four wheels, with an extended cast-iron platform in e rear for the man who works the machine. A crank-pin on a flyeel actuates two bevel-wheels for moving the machine back or forrd on the rails of the gallery.

The handling of this machine is very simple. The workman on the tform turns a wheel so as to bring the pick into the proper direction; then opens a cock admitting compressed air into the cylinder by rking the slide with a lever. The machine being thus set in motion, is merely requisite to move it forward to follow up the work done by e pick. The air, on leaving the cylinder, escapes freely into the llery.

We subjoin the reported results of experiments made by this machine two mines in England:

In the High Royd colliery, in a hard coal, and in a gallery in which e rails were in a bad state, with an air pressure of from 2 to 2½ mospheres and 70 to 80 blows per minute, the average hour's work the machine was a channel from $8^{m}.20$ to $9^{m}.15$ long and from $0^{m}.90$ $1^{m}.00$ deep, including stoppages. The width at the bottom was $0^{m}.037$, d on the face $0^{m}.08$. During 10 hours' consecutive work the work oduced by this machine was equal to that of 20 miners during the me time; and it appears that the consumption of air is equal to about horse-power.

FIRTH'S PATENT COAL-CUTTING MACHINE.

This is also a percussive machine, and is worked by compressed air. is mounted upon wheels which run upon rails on the floor of the ine. A pick is attached at the forward end of the machine to the wer end of a vertical shaft, and a horizontal swing or sweep is given it by means of arms and levers connected with the piston-rod. In its rm and mode of operation, this machine somewhat resembles the preding. Some improvements in this machine have been reported rentl y. It is stated to be working in the seam known as the "Little al," which is 2 feet 8 inches thick, and to have under cut a face of 0 yards in length to a depth of 3 feet, using a new form of the pick ich removes the dirt as it proceeds.

Mr. Firth has also recently invented a method of fitting picks with vable cutting points. It is the general custom to work picks with ints solid; that is, the point and pick in one piece. By this arrangent it becomes necessary to take the whole pick out of the pit wheneer blunted, in order that it may be sharpened. The improvement nsists in making a boss on that part of the pick nearest the point. In s boss is a socket of any suitable shape, by preference a circular taper ket, the loose point being cottered into the socket against a piece of

India-rubber, or other suitable substance, at the bottom of the socket around the outer edge of the socket, so that when the blow is given so part of the strain is taken off the point. The edge of the socket brought as close as possible to the point, for as the socket must ent the groove made in the coal, and must be clear of the top and bott of the groove, and as in some cases the groove is not more than one a three-quarter inches in height, it will be readily seen that the closer t socket is to the point the greater the resisting strength of the point.

HURD'S COAL-CUTTING MACHINE.

Mr. F. Hurd, of Rochdale, England, has invented another form of co cutting machine, in which a number of steel cutters or teeth are plac on an endless chain or band moving longitudinally around a long ar The invention is claimed to consist* in cutting horizontal, longitudin radial, and diagonal grooves in the coal or other mineral to be excavate by means of a series of link stocks containing the cutters, which a jointed together in such a manner that no rivets or connecting pins a required. This series of cutters passes round a pulley mounted in radial arm, and around a toothed wheel fixed to a shaft which fits in telescope frame, to increase or reduce its length; the radial arm is p vided with grooves which support the back of the cutter stocks, and p vent them from being drawn out of the groove in the radial arm. T toothed wheel may be driven to give motion to the cutters by an improv motive-power engine, or it may be driven in any other convenient ma ner.

The position of the radial arm is changed so as to give the required cut a worm fixed to the outer shell of the telescope shaft, and a cam fixed the driving wheel; this cam, by a lever and catch, turns the worm at int vals, and thus advances the cutters to the extent required. The engine c sists of an oscillating cylinder to which the compressed air or other elas fluid is admitted, and from which it is exhausted through two or mo ports, the oscillation of the cylinder causing the ports to be opened a closed at the proper times without the aid of eccentrics or valves giving the requisite to-and-fro motion to the piston and piston rod, whi latter is connected to the crank pin in the fly-wheel. The engine c be reversed by two double taps placed in the passages leading to a from the ports, which taps are connected and worked simultaneously levers or gearing. The cutting apparatus, and the engine by which it driven, are connected to a bracket which fits on a screwed pillar, and is raised or lowered by gearing connected to the engine, and which ge ing reverses the direction of motion up or down by changing the po tion of the wheels. The bracket also supports two shafts with t eccentrics for acting on surface clips, one to secure the bracket in t position required, and the other to secure the radial arm. An apparat for compressing air is also included in the invention. It consists o series of pump barrels, the pistons of which are worked by a diago disk or other equivalent; this disk, or its equivalent, is driven by steam other power, and the pump barrels are all united to the air receiver. the pressure increases in the receiver, the piston rods are disconnect in succession from the driving disk, or its equivalent, until the final co pression is obtained by the last pump barrel. The pumping apparat is placed in a water course to keep the barrels cool.

An idea of the form and operation of the cutting machine may be c ned from the annexed figures, showing a machine designed for working very narrow seams. The first is a plan, and shows the principal

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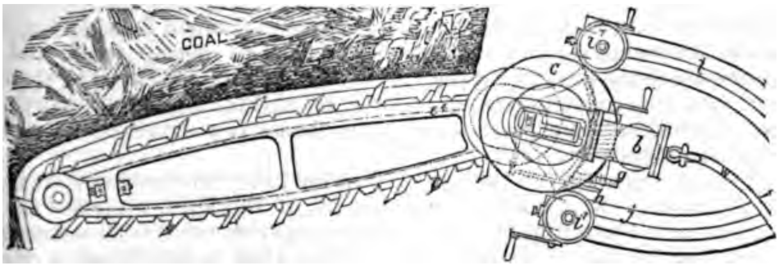
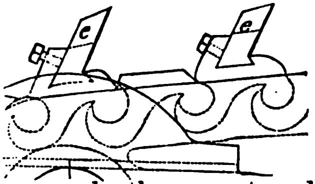
* Described with drawings complete in the Colliery Guardian, November 19, 1869.



Hurd's Coal-cutting machine.



rt of the frame *j j* of the machine with its long arm e^4 reaching forward d carying the cutters *e e*, by which the groove is cut in the coal. Steam compressed air is admitted through the pipe *w* to the cylinder *b*, in iich a piston moves back and forth and gives motion to the fly-wheel *c*. The arm is controlled by a tangent screw working in a segment of a ieel, the outlines of which are shown between *i* and *i'*. By means of is screw, moved by a crank at the side of the cylinder *b*, the arm can thrown to one side or the other. It has a horizontal sweep of three 3t or more, carrying the cutters with it, as shown in the figure, each oth in succession cutting or scraping off a little of the coal. Alternate 3th are different, one cutting a double groove and leaving a little ridge tongue which the next tooth cuts away. The cutter stocks, into which e cutters *e e* are set and held by a screw, are linked together in a pecu-r manner without rivets or pins, as indicated in the figure, which shows ly two of the teeth in the sockets. One cket, by means of the hook-like or curved nnections, holds to the next, and thus form chain which slides in the groove of the m. The figure also shows a portion of one le of the end of the arm, holding the pul-y upon which the chain of cutters turns. y means of a screw and lock-nut this pulley may be thrown outward take up the slack of the chain.

This apparatus is reported to be working in a 20-inch seam, and mak-g a semi-circular sweep of 6 feet 6 inches in four minutes, with only 25 unds pressure on a 6-inch cylinder with six inches stroke, cutting a oove of 1¼ inch. The weight of the machine is nearly four hundred unds. Mr. Hurd has also made a machine to be worked by hand, hich is much lighter.

BREAKING DOWN COAL BY HYDRAULIC PRESSURE.

As it is exceedingly difficult, if not impossible, to secure perfect ven-lation in all parts of coal mines so as to effectually dilute the combusti-e gases and render them inexplosive, it becomes very important to dis-nse with the use of gunpowder, the explosion of which not only fills e workings with smoke and vitiates the air, but frequently ignites the e-damp. It is the opinion of one of the inspectors of mines in Eng-d that half the explosions of fire-damp are traceable to firing shots, d that a vast number of accidents from falls of roof are caused by the ttered condition of shale-roofs, after blasting to the extent now practiced. In dangerous coal-seams it is clearly wrong to use gunpowder, and it is perhaps a mistake under any circumstances. The exceptions are thought to be rare, while the accounts of fatal accidents are numerous.* Wherever much powder is used in getting down the coal, the value of the coal is much lessened. It is a well-known fact in England that the least capable men in any colliery use the most powder, and as a consequence the coal which they mine is less valuable than that thrown down with less consumption of powder, by skillful and experienced miners. Again, in some cases, coal-seams themselves have been ignited by the use of powder.

All these objections to the use of powder have rendered a substitute very desirable. Mr. Samuel P. Bidder, jr., of England, proposes to use the force of a hydraulic press, and has experimented with a machine constructed for the purpose. The machine that he exhibited in model at the Institution of Civil Engineers is described as follows:†

> The principal machine consists of a small hydraulic press, weighing about 60 lbs., and of 15 tons power. To this press is attached a pair of steel tension straps, bent in the form of a tuning-fork, and which are connected with the press by a collar. At the end of these straps is first placed a clearance box, about 4 inches long, and upon each side of the straps expanding pieces, (also made of steel,) which exert a pressure at the sides of the hole, and are 15 inches long. The points of a pair of twin wedges, 15 inches by 3 inches, constituting one wedge, are then inserted in the expanding piece, and the machine is fixed in the hole. The hydraulic press, (having been already charged with about three pints of water, which may be used over and over again without loss,) is then worked by a man by means of a small handle, and the ram from the cylinder is forced out, thus driving up the pair of wedges between the expanding pieces, giving a lateral extension of about 3 inches. This not being in all cases sufficient to bring down the coal, the press is withdrawn, and the relief-valve opened, thereby allowing the water to return to the reservoir. A second wedge is then inserted between the two twin wedges by means of a small rod, five-eighths of an inch in diameter, and, the press being again connected, this wedge is driven home in the manner before described. By this means an additional expansion of 3 inches is obtained, making a total expansion of 6 inches, which in most cases is found sufficient; but a third wedge can be applied, if necessary, and the expansion thus increased to any reasonable extent. In this manner as much as 10 or 12 cwts. of coal have been brought down in ten minutes.
>
> The drilling apparatus, the principal part of the machine, consists of a screw 4 feet by 1½ inches in diameter, to the end of which is attached the drill. The fulcrum for taking the resistance of the screw is obtained by inserting a bar of iron in the coal at the side of the place selected for the hole which the machine has to drill. This small aperture is made by punching with the ordinary instrument a hole 10 inches deep and 1 inch in diameter, and the time occupied in making this preparation is usually about four minutes. The small bar for taking the resistance of the screw is then inserted, and it may either be fixed at the side or in the face of the coal, as the case may require. The screw is then adjusted to this bar, and the drill driven in the coal by a man turning the handle at the end of the screw. The time occupied in drilling this hole for the machine, 3 inches in diameter and 3 feet 6 inches deep, is from 10 to 15 minutes, according to the hardness of the strata; and if it is necessary to drill the hole in such a position that the rotary motion of the handle by which the screw is propelled cannot be obtained, a ratchet may be used, so that, under any circumstances, no difficulty can be felt in procuring the required motion.

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* Another sad illustration of the carelessness of some miners, notwithstanding the knowledge they have of the perils to which they are subjected in the pursuit of their daily avocations, is furnished by a shocking calamity which occurred at the Astley Deep Pit, Dukinfield, on Thursday evening last week, and the cause of which has since been ascertained. Certain parts of the pit are known to be strongly charged with gas, and the colliery regulations very properly prohibited blasting in consequence. In spite of the rule, however, and well knowing, as they must have done, the awful risk to which they were subjecting both themselves and their fellow-workmen, two miners fired a shot in one of the highly dangerous "brows." They have paid the penalty of their hardihood and recklessness by the loss of their own lives; but along with them seven others have also been hurried into eternity. One of these men had been warned before the magistrates of the consequence of neglecting the precautions prescribed in the rules only a few months ago. The inquest was on Saturday formally opened and adjourned.—*Colliery Guardian, March* 11, 1870.

† Mining Journal, June 12, 1869.

The first trial of the machine was made at a pit belonging to the North Staffordshire al and Iron Company, (Limited,) at Talke-o'-th'-Hill, in a heading in what is called e Eight-feet Banbury seam of coal, at a depth of 350 yards from the surface, and under dinary working circumstances, so far as the place selected was concerned. Considerable difficulty is always found in fairly testing a machine under such cirmstances as these, but, notwithstanding every disadvantage, the hole for the maine was drilled and about 4 tons of coal brought down in 25 minutes. Mr. Higson ked a workman in charge of the place how long it would have taken him to have rilled the hole and fired the shot according to the present system of blasting, and he nsidered that an hour would be required for the purpose, and a pound of gunpowder sed, at a cost of 5*d*. The superiority of the machine was, therefore, evidenced by the aving of 35 minutes in time and 5*d*., the cost of powder, and the work was done withut the smallest danger to any one. Two further trials of the machine were made in ther parts of the workings, in both the Seven and Eight-feet seams, with results equally atisfactory. The mode of using the machine in the working of coal would be to proide each set of colliers with a pair of steel tension straps, and the machine could asily be carried about by a man like a double-barrelled gun under his arm from place o place. It would thus be necessary to have only one press for a large number of hese places; the entire cost of the machinery is very small.

SECTION III.—TRANSPORTATION, VENTILATION, ETC.

CHAPTER LXXI.

TRAMWAYS AND WAGONS.

As mines increase in depth and extent, the cost of sinking and main-
ning shafts is much increased, and it is no longer economically pos-
le to keep several hoisting-shafts in operation. It is therefore neces-
y to confine the hoisting to one central shaft, which thus becomes the
y outlet of a constantly extending system of underground tramways,
er which the minerals or débris are conveyed to the shaft in order that
y may be raised to the surface. As the work of extraction of the ore
coal progresses, the distance of the mineral from the shaft, especially
collieries, is constantly increasing, being in some of the European
lieries as much as 4,500 feet or more, and it is thus become a very im-
rtant item in the expense of mining to move the mineral to the shaft.
So, also, when, as is common in California and Nevada, veins are
ched by long tunnels, the tramming or underground transportation
ms a serious item of the cost of getting the mineral to the surface,
d it is important to determine the best forms and sizes of the wagons
d tracks to be used.

TRAMMING AND TRAM WAGONS IN CALIFORNIA.

Very little attention has been given in the mines of the west to this
bject of tramming. The forms of wagons, or "cars," as they are usually
lled, are almost as numerous as the mines in which they are used.
general, they are made of wood (there are some of iron) banded with
on, and are supported upon small cast-iron wheels, running upon axles
the simplest form. The size varies with the size of the tunnels, but
never larger than a man can manage with ease when loaded, except
hen, as at the Mount Diablo coal mines in California, horses are em-
loyed for the haulage. These coal mines perhaps present the best
amples of underground tramming upon the Pacific slope.

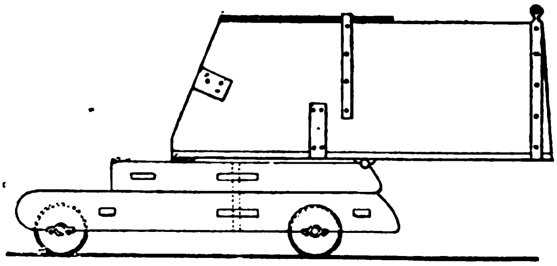
The average distance of underground hauling at these coal mines, is
ow perhaps not far from one-third of a mile. This distance varies, of
urse, in the different mines, and in different parts of the same mine.
he maximum distance of underground haulage is in the old or upper
lack Diamond gangway, which, from its face to the mouth of the tunnel,
now about 4,200 feet. This tunnel is about 400 feet long, before
aching the coal, and extends for the remainder of the distance on the
al and is constantly being worked further. The haulage upon the
orizontal tramways is done by horses at an average cost of not less
an fifteen cents, and probably as great as twenty cents, per ton per
ile.

The sizes of cars, tracks, &c., vary considerably in the different mines,
at the tracks are all alike in their construction, being made by spiking
light strap-iron rail upon wooden stringers supported on wood cross-ties.
light I-rail would be a decided improvement. The cars at most of the

mines have to be made so that they can be used not only on a ho roadway, but also upon an incline. They are therefore built highe than in front, in order to prevent the coal from falling back o full cars as they ascend the slope. At the Mount Hope slope, le the lowest level of the Black Diamond mines, and pitching at of 37° 15′ to the south, the cars, built of wood and sometimes iron, have the following interior dimensions: Length, 6 feet 6 width, 2 feet 5 inches; depth in front, 2 feet 5 inches; depth end, 2 feet 11 inches. The width of track is about 36 inches cars hold about a ton of coal and they are drawn up the sl steam winding engine. Some details concerning this hoistin given beyond.

TRAMMING UPON THE COMSTOCK LODE.

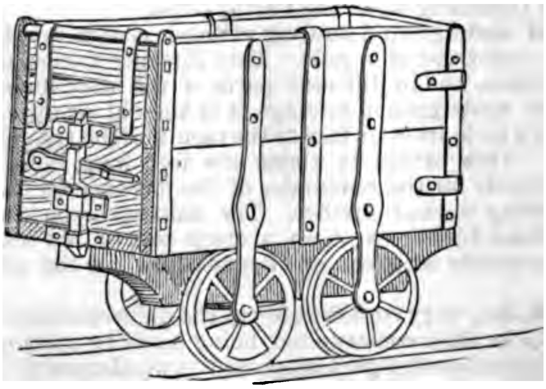
The annexed figure, drawn to one-twentieth of the full size, s construction of a dumping car, made of wood, designed to run eq on a horizontal track, upon a steep incline, or upon the surfa the form us years since Ophir mine, Comstock lo body of the c ported a littl of its center extreme en strong fram turns upon pivot and re a lower frame carrying t wheels. This arrangement for turning the car upon a pivot load to be dumped on either side of the raised track at the du ore, or at the attle-heap. The forward end is closed by a opening outward, suspended on an iron rod, extending from of the car to the other. The back end of the car and half its l top are closed with planks, secured by strong iron straps.



Dumping Car for inclined shaft or gallery.

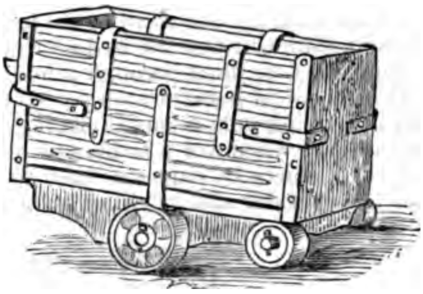
UNDERGROUND TRAMMING ABROAD.

The next figure represents the tunnel car used at Freiberg. The load is upon the axl timber extendi tudinally in th under the car.



The wheels good size, and ends of their supported by t iron bands d from the side o

The next fi recall to the those who hav the Freiberg m "hund," or do monly employed in that district. It is of wood, bound with ıstructed of such a size as to be managed, when loaded, by a single n. The axles are fixed, and the car is turned, when necessary, by ing it so as to lift the forward .e and leave the weight resting the two larger wheels only. ese dogs are particularly useful mines where tracks have not en laid. Their broad wheels ena- them to go through ordinary lleries, or over the inequalities of e surface. They are generally, wever, run on strips of boards, ways otherwise prepared, to ninish the labor of the miners opelling them.

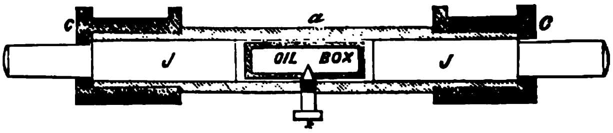


The rapidly increasing production of the coal mines of Great Britain d the Continent has necessitated great improvements in the methods transportation underground. The wagons used for the purpose and ir running gear are no longer roughly and rudely constructed, but made with great care. The wheels are accurately made, well bored, l fitted with carefully turned axles, and these are kept well lubricated grease-boxes, so as to prevent loss of power, wear, and friction. n France and Belgium a few years since a plain flat rail, set on edge l tightly wedged into the cross-ties or chairs, was preferred to any ıer. The size of the iron depended upon the weight to be sustained. r cars carrying 500 kilogrammes, 0 .055 by 0^{m}.011 was sufficient; t if the track was to be used for a long time, heavier iron was pre- red. The width of track was, and is, in general, from 0^{m}.60 to 0^{m}.80. the Blanzy collieries, where the cars carry about 1,000 kilogrammes, ıe ton,) the width is 0^{m}.80, and the flat-bar rails measure 0^{m}.07 by .02.

At the Anzin collieries it is found advantageous to use iron cross-ties, th chairs welded or riveted to the ends, in preference to cross-ties of od. Rails with a rounded summit, and thicker at the base than the p, were in use there in preference to the square-edged rail, but these ve in turn given place to a light I-rail. It was calculated by Burat 1861 that the tramways at Anzin, 0^{m}.60 wide, and with cross-ties of n at distances of 0^{m}.80, did not cost over five francs per lineal metre. But great improvements have been made since that time, and in the pplément au Matériel des Houillères, Professor Burat states that the nclusions arrived at, after very careful investigations of the methods, : 1. That the narrow-gauge tracks, those, for example, of 0^{m}.50, are most desirable. 2. That the flat rails and bar rails on edge should abandoned for rails presenting at least two centimetres of bearing face to the wheels. 3. That the charges for the cars should not be ater than 400 kilogrammes, net weight, in order that the attendant y easily turn the car on curves of short radius, or put it upon the ck in case of its running off. Light I-rails are in use in some of the lieries, as well as the method of oiling known as Évrard's, by means an oil-box placed in a hollow axle.

SELF-LUBRICATING AXLES.

vrard's contrivance is described in the reports upon the Paris Exposi- n. It is designed to supply oil in moderate and regular quantities to the rnals or bearings of the wheels of wagons for underground tramming, and for excluding all grit and dirt from the bearing surfaces. The wheels are supported by journals J J, working in a hollow cylinder or box *a* extending across the bottom of the car. This cylinder is calibered at each end, for one-third of its length, for the reception of the journal. The middle third of the cylinder is left rough, and receives an oil-box, which may be filled through a hole in the cylinder, closed by a screw s, with a conical point, which enters the oil-box and nearly closes the hole in it, leaving only a small opening, through which oil can exude in small quantities whenever a bubble of air enters. The journals are retained in their places by caps *c c*, fixed to the truck and fitting over the ends of the cylinder and catching upon a shoulder left upon the journal.



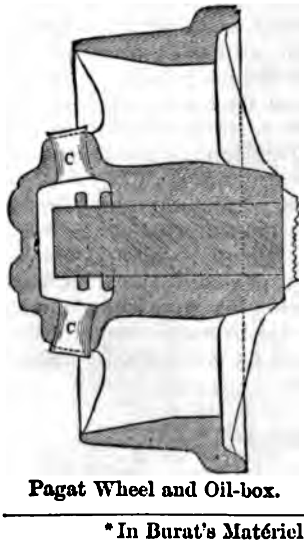
Évrard's Self-lubricating Axle.

Axles of this kind used upon wagons at the mines of the Vicoigne Company consume a decilitre of oil in running an aggregate distance of 150 kilometres—about 62 miles. Oil is renewed every fortnight.

M. Évrard, in his description in detail,* states that a car with its two axles did not consume more than three decilitres of oil in 22 days' running, the total distance run having been 448 kilometres.

Since the Exposition of 1867 a commission of mining engineers has been organized in Belgium for the purpose of studying the different forms of cars and tramways in use in the coal basins of the north of France and in Belgium. The car designed by M. Parent has been introduced in many of the mines of the Anzin company, and appears to give great satisfaction. The body is rectangular, $1^m.10$ long, $0^m.778$ wide, and $0^m.57$ deep; capacity, five hectolitres. The body is made of iron, two millimetres thick for the sides and four milimetres for the bottom. The total weight of the car, with wheels of wrought iron, is 190 kilogrammes, and with cast-iron wheels, 210 kilogrammes. They cost 96 francs each, with cast wheels, and 102 francs with the wrought-iron wheels. These wrought wheels are stamped from a single piece of iron, are $0^m.28$ in diameter, and weigh 8 kilogrammes each. They are much lighter and less liable to break than the cast-iron wheels.

At the Chazotte collieries, M. Max Évrard has adopted the Pagat wheel and axle. This is a broad-faced wheel of small diameter, the form and construction of which may be best understood by reference to the annexed figure, which is a section through the center, showing the end of the axle and the oil-box. This oil-box appears to be the chief merit of this wheel. The end of the axle protrudes within it, and the wheel is held in place by a simple spring linchpin inserted through one of the large holes made in the hub to permit the introduction of the grease from time to time. These two openings are closed by corks *c c* only. A



Pagat Wheel and Oil-box.

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*In Burat's Matériel des Houillères—supplément, 1865, pp. 12–14.

ıse or tallow is used, and is inserted by means of an injector. r movement of the wheel the axle warms a little, the grease elts and runs into the bearing so gradually that it need not be oftener than twice a week.

ling to M. Évrard this box once filled with grease is sufficient for a distance of sixteen kilometres. It holds 128 grammes; the sts 52 francs per 100 kilogrammes, and the expense per ton, per), is, consequently, for the four wheels of a car, 0 fr.0455. These re used under an oval tub car, the capacity of which is limited logrammes.

nzy, the cars are rectangular, expanded over the wheels; carry of 600 kilogrammes and weigh 230 kilogrammes. The wheels n the axles, and the axles turn in boxes fixed to the body of the

USE OF SMALL TRAM-WAGONS.

th Wales it has been argued that small tram-wagons are more al than large ones, since they permit less height of the drifts, of tramways, and the use of ponies and boys instead of horses. eting of the Institute of Engineers it was stated that at a colhe Aberdare Valley there had been effected, by the introduction trams, a saving of 1*s*. a ton. The vein was 3 feet 8 inches d the old principle was to cut as much as 6 feet 6 inches for r and horse-road. But upon the introduction of the small trams e depth to be cut was 4 feet 6 inches; and, consequently, there ving of two feet in top or bottom—the top being a hard cliff. ıg out 150 tons a day with the large tram, fourteen horses were l, at a cost of £4 12*s*. 8*d*.; with small trams, the same amount work was done for £1 11*s*. 8*d*.—that was the cost of ponies, d jiggermen—so that there was a saving of nearly 6*d*. a ton on ı alone.

: other hand, it was asserted that it is certainly possible to derge tram with a smaller tare in proportion to the load than tend a tram with a capacity of only six or ten hundred-weight; her, that it is very doubtful whether a saving of one-third could in the cost of hauling by the use of ponies rather than horses. ›llowing figures were given as showing the comparative cost of with large and small trams in the same colliery—No. 3 vein. ıried from 2 feet 6 inches to 3 feet 6 inches or 3 feet 9 inches.

	Tram of one ton.			Tram of ten hundred weight.		
	s.	*d.*		*s.*	*d.*	
cutting coal	2	0	per ton.	2	0	per ton.
bottom for horse height	0	3	per ton.	0	1½	per ton.
underground	0	4½	per ton.	0	3½	per ton.
coal in stalls	0	2	per ton.	nil.		per ton.
;, screening, &c	0	1½	per ton.	0	1	per ton.
otal	2	11		2	6	

; a saving of 5*d*. per ton in favor of the small tram. But it ıitted that with a thick vein these items might be altered ma-

s a matter upon which no general rule can be established; the ill of necessity be governed in the choice of the form and size ›ns by the peculiar local conditions of the colliery.

PORTABLE TRAMWAYS.

In coal cutting or drilling by machinery, or in any mining work where rapid advances are made, it becomes important to be able to quickly extend the tramway or track so as to keep the machine well up to the face. To facilitate this, Mr. Firth, of England, who has made and patented several improvements in coal-cutting machines, proposes to make the ties or sleepers in such a form that the rails can be twisted or sprung into them. His plan is described in an English journal as follows:

> It is the present custom in fixing the railroad for coal-cutting machines, to use rails about four yards in length, having one sleeper for each joint and one or more intermediate sleepers for each pair of rails. The kind of sleeper hitherto used has been of such a form that the intermediate sleepers have to be hammered on and off each time the road has to be removed nearer to the face of the coal. The improvement consists in making the intermediate sleepers of such a form that rails can be twisted out of and into them, instead of hammering the sleepers off and on to the rails, which improvement tends to a great saving of labor and time in making the railroad for coal-cutting machines, and subsequently in taking it to pieces and putting it together again whenever it has to be removed. At the outer end of the sleeper is a lug under which the outer flange or edge of the foot of the rail enters, and the foot of the rail then drops below a stop on the sleeper, which prevents the rail escaping laterally until its inner edge is intentionally raised. The same form, or a modification of the same form, can be applied to the tramroads of mines generally, also to sidings and railroads of other descriptions, and by this means no wooden wedges or keys are required to keep the rails in their places.

TRAMMING BY STATIONARY ENGINES.

In Belgium the formations through which the galleries of the mines are cut are so soft, and undergo such continual change by swelling, that it is not practicable, except in rare cases, to establish a system of hauling the coal by stationary steam power such as has been successfully introduced in the English collieries.

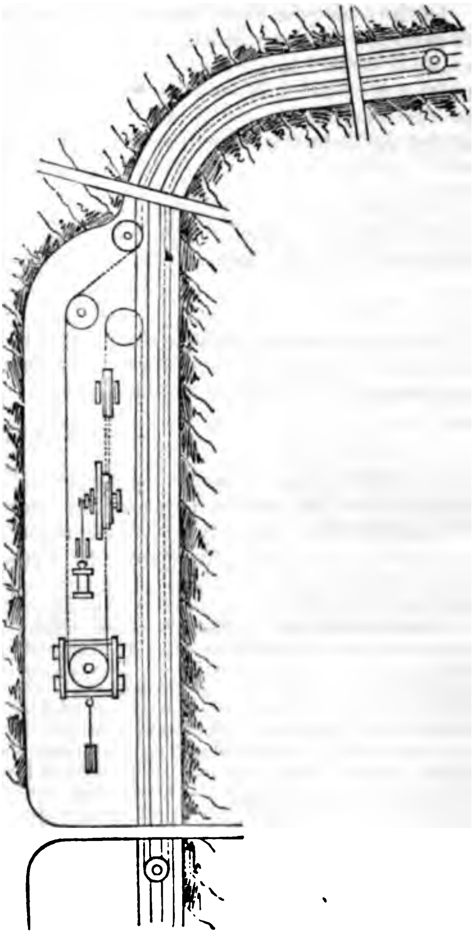
In most of the coal mines of England the regularity of the strata is such that a shaft may be used for a long time for the extraction of an enormous amount of coal brought to the shaft from great horizontal distances below. It is not unusual to see in Great Britain shafts from which 600, 1,000, 1,200, and even 1,500 or 1,600 tons are extracted in twenty-four hours. Such an amount of work, extending over great periods of time, requires all the parts of the shaft to be constructed in a solid and permanent manner.

For the conveyance of such immense quantities of coal to the shafts it is necessary to use power greater than is afforded by men trundling the wagons in the usual way. The coal is loaded into wagons containing from 350 to 450 kilogrammes each, and five or six of these wagons are then formed into trains, which are drawn by horses to the main tramways, which vary in length from a few hundred yards to even a mile.

Tramways may be divided into three classes: first, those in which the slope toward the shaft is sufficient for trains to descend by their own gravity, and, in descending, to draw up the empty trains; second, those in which the grade is reversed, and sufficient to permit the empty trains to descend from the shaft to the end of the road by their own gravity; third, those in which the bed or grade is horizontal, or nearly so, necessitating power for the movement of the trains either way.

In the second class the loaded trains are usually drawn up toward the shaft by means of a cable wound upon a drum by a steam engine, while the empty cars are lowered by a cable unwinding from the same drum.

ird class an endless rope or cable, which traverses the gallery
e track between the rails, is moved by an engine, and the trains
led to this moving rope
arried to their destina-
. few details upon this
ss of tram roads may
able. It is understood
louble track is laid on
ls where this method of
he trains is used. The
arrangement of the ca-
engine, &c., are shown
gure in plan showing
ks, the engine, &c.
riving engine is gen-
aced in a recess cut at
of the gallery, and
air-shaft, by which the
rom the furnaces can
The cable is wound
rum, and is supported
ut its course by hori-
llers, and in the curves
d by vertical rollers.
ends of the route the
rns upon drums placed
the tracks, the diame-
ich is equal to the dis-
m center to center of
s. In some cases the
n for a part of the dis-
derground. In order
e a proper tension of
e, it is passed over a
pon a movable frame,
oised in such a way as
p the slack of the ca-
ive a constant tension.
e travels constantly in
tion, and thus moves
ways upon the two tracks. Trains of twenty or thirty wagons
oved by this arrangement.



Tramming by steam-power underground.

rly in some mines the engine was established at the surface,
able was guided to the bottom by pulleys and sheaves; this
irst plan adopted, but it occasions too much friction and wear
pe, and now the engine is always placed underground.

rt or stop the trains it is not necessary to stop the cables. There
uctor in the first wagon of each train. When he wants to put
in motion he lifts up the cable with a hook, makes it pass along
block fixed under the wagon, and by means of a lever he
rward a wooden wedge, which squeezes the cable against the
lock. Cable and wagon, being then connected, move together.
avering his lever the other way, the conductor disconnects the
stops the train. When the train arrives opposite the machine,
the cable runs under ground, the conductor loosens the rope
train runs alone. The momentum carries the train up to the

point where the cable reappears; the conductor then again connects the rope to the train as before.

In the coal mines of Pelton the principal road is 1,500 metres in length. It is partly horizontal and partly on a slope of five degrees. The driving cable is $0^m.022$ in diameter, its running speed is $6^m.00$ per second, and it carries a train of 30 wagons; the width of the rail is $0^m.60$; the strength of the motive power is 40 horse-power; and the cable transports 2 trains in 12 hours, representing a duty of 560 tons of coal.

	Francs.
The labor costs	13.50
Coal (refuse) for fuel, 6 tons at 3 francs	18.00
Repairs, interest, &c	76.50
Total	108.00

Which represents a cost of 0.137 franc per ton per kilometre. Under the most favorable conditions transportation by horses costs 0.21 franc per ton, and by trammers, 0.67 franc.

GRIP PULLEYS.

In hauling heavy loads up inclines in mines or elsewhere, the grip pulleys may be used with great advantage. Mr. A. S. Hallidie, of San Francisco, has recently invented a pulley of this description, which is noticed as follows in the Scientific Press of that city:

> Its novelty consists in so arranging the two gripping jaws or clips, that they will be operated by the strain upon the rope, without the necessity of bolts, rivets, screws, or other device for holding them in place. The rim of the wheel is made in two parts, one of which is formed solid with an arm, and of only half the desired thickness of the rim, so that it forms a shoulder. This is then bolted or riveted to the other part, thus forming a rim of the required thickness. The flanges, between which the gripping jaws or clips are placed, are simply spread apart in the ordinary manner of forming the groove in pulleys. At intervals around the entire grooved periphery of the wheel are cavities or recesses, placed opposite one another in the two flanges. These are made widest at the lower part. The clips or jaws are made with spreading arms, so as to admit the rope easily, and the corners extend into the cavities just mentioned, thus preventing their dropping out, while allowing of a slight motion to and from one another. A groove or space is made just below the point of meeting of the clips, so that when the strain comes on the rope or chain, which rests on the bottom of the groove between the two jaws, the central part of each clip will be depressed, thus causing the jaws to grip the rope and prevent its slipping, while the strain is on, but as soon as this is removed, the jaws will work freely in their sockets and allow the rope to open them, and thus free itself from the pulley. This invention, in which the jaws are operated automatically by the strain on the rope and their own weight, is exceedingly simple and effective, has no complicated parts to get out of order or break, and is cheaper than other kinds.

TRAMMING BY MINING LOCOMOTIVES.

Many efforts have been made to substitute small locomotive engines for animal power in underground haulage, especially where the amount to be moved is constant and large. In some of the Pennsylvania collieries such locomotives are now successfully employed. The first machine of this kind was built for the Lehigh Coal and Navigation Company by Messrs. Grice & Long, of Philadelphia. It is a locomotive of peculiar construction, measuring 12 feet in length by about 4 feet 4 inches in width, and 6 feet in height from rail to top of stack or roof. It weighs 11,000 pounds, with water and fuel. The wheels are about 2 feet diameter, are four in number, and are all drivers. Distance between the wheels, 5 feet 6 inches; gauge of track, 3 feet 6 inches; rails, 40 pounds per yard.

he work to be done is to draw the wagons or "cars" from a "coal
aker" into the mine, a distance of about 7,500 feet, 5,500 feet of which
a what is known as No. 5 Tunnel, near Summit Hill. A great part
he road is in a gangway in the coal of a seam overlaying that worked.
the coal is a hard anthracite, there is no danger to be feared from

he working expenses of the engine for two months are known with
uracy. In order to compare them with the cost of doing the same
unt of work by mules, we will assume the mine to be working to its
capacity, 600 tons of clean coal per day. To do this work with
es would require the handling of 300 "cars" of two tons each (99
ic feet) per day, and about 40 cars of "slate," "waste," etc. To haul
e over 7,500 feet of road, requires three teams of seven mules each,
wing 20 cars in a train; there are needed, therefore, three sidings to
s trains on, and 60 cars are on the road at a time; there will at the
e time be 20 in the mines, and 20 outside; in all, 100 cars will be
ired to do the work. The wear of the roads by mules, requires the
stant work of one man to keep them in repair.

o do the same amount of work with the locomotive requires but 50
, since the engine takes in a train of 15 cars in less than half the
e required by the mules; 15 cars in the mine and 15 outside, or say
n all, suffice to "handle" 600 tons of coal per day. There is but one
ling" required by the engine; it is at the end of the road, and is
nged with an air shaft to carry off the steam and gases from the
bustion of the coal.

he engine has abundantly proved itself capable of drawing 15 to
cars, the road being so graded as to make the work of drawing the
led wagons out, no greater than that of taking the light ones in.
maximum speed is 9 miles per hour, though it does not run at that
s "underground"—it draws a train with ease round a curve of 75
; radius.

he following comparison of the expenses attending working with
locomotive and by mules has been made:*

Locomotire per day.		*Mules per day.*	
gineer	$3 50	21 mules, at $1 per day	$21 00
y	1 25	3 drivers	6 30
airs, oil, fuel, &c	1 55	Extra cost of keeping road in repair	2 00
Total	6 30	Total	29 30

wing a balance of $23 per day in favor of the locomotive.

he men are sent in to their work on the wagons. When these are drawn in by the
ine, there is a saving of 15 minutes, morning and evening; and as one miner cuts, on
verage, 14 tons of coal (clean and prepared for market) per day, and has one laborer
ad the same, it will effect a saving of 30 minutes a day for eighty-six men, or four
, at $2 = $8 per day, by using the engine for this work. The average of 14 tons per
is above that performed by the miners, generally, throughout the anthracite
es, owing to the high inclination and great thickness—from 20 to 50 feet—of the
as in the Panther Creek Valley. In the Wyoming coal-fields, the average amount
oal mined per man per day, is about 10 tons.

we consider the first cost of the motors referred to, we find:

omotive	$3,000	21 mules, at $200	$ 4,200
ine wagons	6,250	100 mine cars, at $125	12,500
ling, say	1,000	3 "sidings" for passing trains	3,000
Total	10,250	Total	19,700

wing a balance of $9,450 in favor of the engine.

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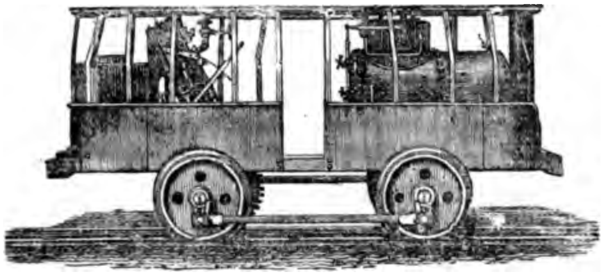
* R. P. Rothwell, mining engineer, in the American Journal of Mining.

Taking the interest on the above at 10 per cent., and allowing 200 working days p
year, since these mines are not worked during the winter, and counting twenty ce
per day for keeping each mule 100 days in winter, we obtain a total saving of $
per annum, or more than six cents a ton upon the coal mined, effected by the in
duction of the locomotive.

The constructors state that this comparison of a few of the princi
items of cost and working expenses may be accepted as substanti
correct for the location referred to. The actual working of the loco
tive justifies the conclusions deduced, yet its introduction is still
recent to warrant a very positive assertion that the results will alw
show so large a balance in its favor.

Since the data were obtained for the foregoing estimates, another
an improved mining locomotive has been put into the mines, and
manager of the colliery reports that both have proved eminently
cessful. Two more have since been added to the list, and the sa
effected by their substitution for mules is so great that it will
cover the first cost of the machines.

The general appearance of these locomotives is shown by the fig



Mining Locomotive.

They are built
low and compac
as to pass thro
the galleries of
mines, and to
any required ga
from 2 feet 6 inc
upward. The hei
sometimes does
exceed 5 feet f
the track to the
of the smoke-sta
It is of course desirable, where there is head room, to give a gre
height to the stack. These locomotives will haul from 50 to 120 t
gross load, the capacity of the engine being controlled by the gaug
track and the head-room. The mine-locomotives weigh from 9,00
12,000 pounds each, and work well upon a 28-pound rail. For out
work, taking the coal to the breakers and returning the empty cars;
bituminous coal pits for conveying the coal to the point of shipme
air furnaces, quarries, &c., they are built from four to nine tons
weight, each size increasing by one ton.

All these engines are remarkably open and accessible for clean
and repairs, there being no part that cannot be readily reached. C
sidering the very limited space afforded by the mine gangways,
constructors of these locomotives have been remarkably successful
combining the boiler and machinery so as to effectually meet the
quirements of the work.

SURFACE TRANSPORTATION.

At most of the mines in California and Nevada, the cars used in
mine are taken to the surface and used there also to convey their l
to the dump-pile or into the mill. But when the point of delivery is
removed from the mouth of the mine, the mineral is either thrown i
enormous wagons, to be hauled by horses over the common roads, or i
larger cars, running upon rail.

The two most notable examples of mining railways in California
the road at the Pine Tree and Josephine mines, in Mariposa County,
the railway leading from the Mount Diablo mines to the point of s

ment of the coal at Antioch, upon the San Joaquin River. The road at the former place is built from the mouth of the mines to the mill on the Merced River, and has a zigzag course along the almost precipitous slopes f Hell's Hollow. The cars, loaded with quartz, are formed into trains nd descend by gravity along the steep incline, the speed of movement eing controlled by brakes; the empty cars are drawn up by mules.

On the road from the Mount Diablo collieries, the haulage of the cars effected by locomotives of peculiar construction, very compact and small, as to pass readily through a low and narrow tunnel. These engines ork on a grade of 275 feet to the mile for one and a half miles, and on an ght-degree curve, carrying 30 tons, at the rate of twelve miles per hour. hey are coal-burning; cylinders 14 by 18 inches; six driving-wheels, three et in diameter; and each locomotive weighs 25 tons.

These, the first mining locomotives built in California, were designed d constructed at the Union Iron Works, San Francisco, by H. J. Booth Co.

In Nevada, a road has recently been built from Virginia city, upon the omstock lode, to the Truckee River.

In the annual report of the Gould and Curry Mining Company, President Bull alludes to the advantages, present and prospective, of this irginia and Truckee railroad, toward which the trustees had advanced 40,000. In a previous report, it was estimated that these advantages ould result in a saving of 34 per cent. in the annual expenses of the ine. Though the railroad was at that time not yet completed, there ad been already a marked reduction in the cost of wood and timber. here had also been a considerable saving in the amount of supplies necesry to be on hand. At the close of 1868, the supplies at the mine mounted to over $80,000. To have provided for such supplies for the inter of 1869–'70 would have rendered an assessment of $7 per share ecessary. The railroad will permit the company to draw their supplies s needed throughout the year, and hence the value of the supplies at resent on hand aggregates only about $30,000. Instead of paying $15 er cord for wood, the price has been reduced to $11 50, while for spring delivery contracts were offered at $9 per cord.

At the mines of the Red Mountain Company, Silver Peak, Nevada, here is a fine surface railway, about a mile and a half long, and remarkable for the boldness of its curves and grades. The loaded cars descend upon it by gravity, and the empty cars are drawn up by mules. The road winds along the mountain side, "heading" the numerous cañons, until it arrives at a point above the larger dumps, where the ore is to be deposited to be removed in wagons. The remaining descent to the dumps could not be traversed by the road, even with such curves as had been employed above, except by enormously expensive trestle-work or masonry. The only practicable route required an acute angle in the road, and this was in fact introduced, by means of a back switch, the suggestion, I believe, of Mr. J. E. Clayton, the superintendent. The track runs past the point of turning, and, for a few yards, up hill. The car, rapidly descending, shoots by the switch, and its velocity is diminished by the up grade. It is stopped with the brakes, the switch is changed, the brakes are opened, and the car starts again by gravity, and runs back to the switch, where it is deflected upon the next descent at an acute angle to the last. The whole operation is performed in a few moments by one man. By the use of such back switches, a surface tramway may surmount great difficulties of ground at small cost and trouble. The dumps of this company are like those of the Comstock mines. The ore is taken from them by large "back-action" wagons, and hauled six and a half miles further, to the mill, over an excellent wagon road, constructed at great expense, and presenting so uniform a down grade that fifteen or twenty tons or upwards can be hauled on it by a team of eight or ten mules. It is my impression that the wagon-road cost about $20,000, and the railroad about $15,000.

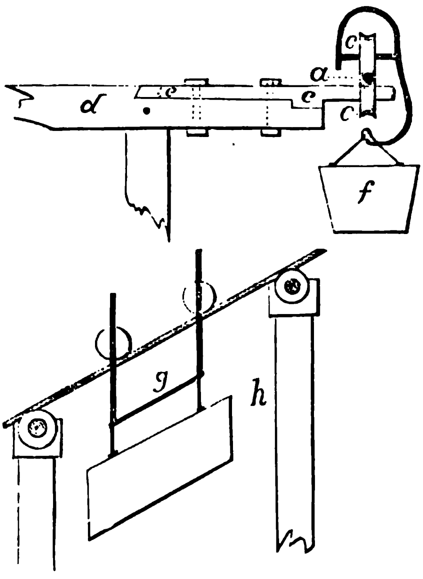
TRANSPORTATION UPON WIRE ROPE.

Mr. Charles Hodgson is the author of a system of transporting by suspending the load upon a moving endless wire rope. This rope is supported on pulleys sustained by posts about seventy yards apart on the average, passes around a clip-drum at the end, and is worked by an ordinary portable engine. The rope moves at a speed of about five or six miles an hour, and the boxes suspended from it carry from one to five hundred-weight each. They are so attached that they pass the pulleys with ease. The full boxes hang on one side of the supports, and the empty ones on the other side. About thirty-five miles of line have been completed, and about one hundred miles in length are constructing. The cost of a line capable of transporting one hundred tons a day is about £400 per mile, and the average cost of transportation, including maintenance, is about twopence per ton per mile.

TRAMMING UPON A FIXED ROPE.

An interesting example of transportation upon a stationary wire rope, used as a track, stretched tightly upon posts, is found at the Brown mine, Colorado. This mine is on a steep mountain slope, about sixteen hundred feet from the mill below it, and the rope is used to convey the ore from the mouth of the mine to the mill. Two one-and-a-quarter inch wire cables are stretched between the two points, one for the descent of the loaded cars, the other for the ascent of the empty cars. The cable is sustained upon the projecting end of a horizontal beam, *d*, tipped with an iron bar, *c c*, as shown in the annexed figure. Its upper surface thus forms an unbroken track. The cars *f* are suspended upon it by means of a curved frame-work of iron, *g*, in which there are two wheels, with hollow faces to fit the curvature of the cable.

The descent of the loaded cars draws up the empty ones on the other track by means of a small iron rope, half an inch in diameter, by which also the speed is regulated.



Transportation of ores upon Wire Rope.

AUTOMATIC DUMPING.

At the Mount Diablo mines, California, there is, at the Hope colliery, an automatic arrangement by which the mine cars empty themselves

the bunkers. The forward end of each car is closed by a flap-door,
ig upon a rod at the top in the usual manner, and secured by a latch.
the cars come to the surface, each one is switched off upon a separate
nch track, leading to a little platform at the head of the screen, over
ich the coal runs from the cars into the bunkers. This platform is
t wide and long enough to receive and hold one car, and is hung upon
nnions at the side of the track, and about two feet higher than the
ls. The T-rail is used upon the platform, and at the front end of the
er the rails are curved upward and backward for eighteen inches or
feet, so as to fit and receive the forward wheels of the car, and hold
pon the platform while the whole tips forward. As the loaded car
s on the platform the wheels strike the curve of the rails, and the car
opped; but as the centre of gravity of the loaded car is somewhat
her than the trunnions of the platform, the momentum tips the plat-
n and car forward and the load is discharged. As the car tips for-
d, the latch strikes against a bar of iron and is withdrawn, so that
door drops open. The larger cars, in which the coal is transported
he vessels at the river, are discharged by a similar device, except
the platform is tipped by a hand crank and gearing. The arrange-
t of the small cars for automatic dumping is similar to that at
zy, except that there the rail is re-curved backwards far enough to in-
e both wheels, and the forward wheel, instead of striking the rail,
s upon a piece of timber by which the shock is deadened. The
nions are bolted to a vertical plate of iron, which supports the track
w, and is prolonged above so as to overhang the body of the car,
help to retain it when inverted.

OILING THE AXLES OF TRAM WAGONS.

contrivance, known as Halliday's, for oiling the axles of tram wag-
or cars, which has been in use for some time at Mesne Lea colliery,
land, consists of an open vat, or tub, placed under the track and
d with a small force pump in the center. This pump has two spouts
ts, drawn to a point like the tube of an oiling cup, and then rising
he level of the axle-bearings. Oil being placed in the vat, and the
having been run over it into the proper position, so that the jets are
site the bearings, the attendant presses with his foot upon a lever,
ch moves the piston of the pump and throws the oil into the bear-
. The excess drips back into the vat, and is not wasted upon the
nd, as is ordinarily the case.

CHAPTER LXXII.

HOISTING MACHINERY AND APPARATUS.

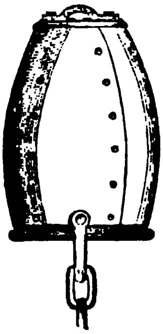
he simplest form of hoisting apparatus is the common hand-windlass,
a bucket made of the half of a barrel, familiar to every miner.
exico, and frequently in Arizona and Nevada, the bucket is repre-
ed by a rawhide sack, which has the great advantage of being light,
ng, durable, and cheap. There are no hoops to fall off when it is
and it cannot be stove by falling down the shaft.

periments have been made with the windlass in Great Britain and
he continent. Weisbach says that two men can raise a weight of
ounds 2.4 feet per second in a pit 120 feet deep throughout a period

of eight hours. This is equal to about 8 tons 12 hundred-weight per day. Mr. Walker, in England, supposes two men raising coal from a depth of 150 feet. One man can exert a force of 12 pounds at a speed of 220 feet per minute. To convert into foot-pounds, we have: 12 × 220 = 2,640 foot-pounds. Then, 2,640 × 60 minutes × 8 hours × 2 men × 150 feet = 7 tons 10 hundred-weight 96 pounds, raised by the two men in a day. This shows theoretically what *can* be done. Practically, such results are not attained.

As the depth of the pit or shaft increases, a horse-whim is substituted for the windlass, and this in turn is displaced by water-power or a steam engine and hoisting gear, with horizontal winding drums. Horse-whims of good construction have drums from eight to twelve feet in diameter, but they are often larger. The arms attached just below the drum are from 30 to 36 feet in length. In Mexico whims of enormous dimensions are constructed for hoisting from the large and deep shafts, and they require ten or twelve horses. As the strength of the hoisting apparatus is increased, the size and weight of the buckets are made to correspond, and iron is substituted for wood, or the tubs are made of plank and are heavily ironed.

KIBBLES.



Cornish Kibble.

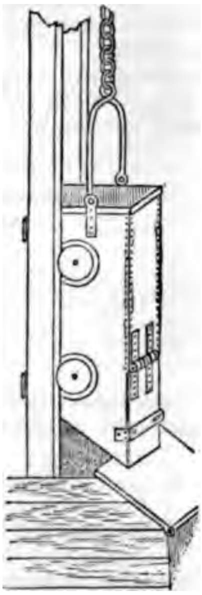
Probably the best form of mining bucket, and one which is more or less in use in California, is the Cornish kibble, a cylindro-conical vessel, made of iron, in plates one-quarter of an inch thick, and strongly riveted together, as shown in the figure. A kibble of medium size weighs three hundred-weight, and has the following dimensions: height, 34 inches; diameter at the top, 22 inches; at the bulge, 24 inches; at the bottom, 15 inches. The charge is seven hundred-weight. But this weight is too great for horse-whims; and for these the kibbles are made smaller, weighing from one to one and three-quarters hundred-weight, and holding a mean charge of two hundred-weight.

At Drakewell's, Cornwall, some years ago, kibbles were in use weighing 4½ hundred-weight; charge 15 hundred-weight; height, 36 inches; diameter, 33 inches.

When a loaded kibble is brought to the surface it is inverted and discharged by inserting a hook, at the end of a hanging chain, in the loop at the bottom; the kibble is then lowered and becomes suspended by the bottom while the load falls out.

SKIPS.

Kibbles or buckets swinging freely in the air can only be used in large and vertical shafts, where there is room for them to ascend and descend without striking the sides. In narrow shafts, and particularly in those which for a part of the way are not perpendicular, but inclined, it becomes necessary to confine the buckets to a certain path, and this is done by means of guides placed along the sides of the shaft. Buckets or boxes so guided are known as *skips*, and have been much used in Cornwall and in some of the gold mines of California. The annexed drawing of a skip used at the Princeton mine, Mariposa Estate, will serve to show the construction. It consisted of a rectangular box, made of boiler-iron, one-quarter of an inch thick, and strongly riveted with angle-irons in the corners. It was 5 feet 5 inches in its greatest length, and two feet square in section. The wheels, one foot in diameter, ran rt axles bolted to the side of the box, and served to support it ısing along the inclines, and to keep it in place when rising the vertical guides. These guides were of ıy 6 inches square, and faced with a strap- ɔrt bars of iron, or "rubbers," projecting skip behind these guides, together with the ı front, served to keep the skip in position. ɔm was made inclined, at an angle of about s, as shown in the figure, and the load was ·d through a flap-door, secured by massive front. On rising to the top of the shaft, it ›en two oaken trap-doors, which fall back and opening as the skip passes, and in the de- the skip for dumping, its inclined bottom n one of these doors, inclined at a similar 'he door serves also as a chute to direct the a car placed to receive it below.


Skip—Princeton mine.

:he Princeton mine was in its best condition, ed with most vigor, the hoisting was effected three shafts, all within a distance of about ınd with three engines. They took out an ·f 180 tons a day, working one shift of eight y, for a long period, and sometimes 200 tons isting in skips, a ton at a time in one, and ds in the other. The main shaft, where the nount was hoisted, was at that time 330 feet

ps in Cornwall weigh from 6 cwt. to 9½ cwt., and the charge m 11 cwt. to 12½ cwt. Skips are applicable, especially in mines ned or crooked shafts, where for a part of the course the hoist- ›n a slope and in another portion is vertical. At the Amador ıyward's,) instead of skips, cylindrical iron tubs, guided along of the shaft by two strong stringers of timber faced with iron, se for several years. The cylindrical form of the tubs per- em to rest in the angle between the two guides, and a rounded) top and projection at the bottom were the only points of con- the guides; the body of the tub was thus kept from wearing. ›s were about six feet long and twenty inches internal diame- :his arrangement of the two tubs, one descending while the ascending, both the ore and water of the mine were brought to :e. Pumps have since been introduced for raising the water, eve the ore is hoisted as before.

COST OF HOISTING IN CORNWALL.

ıteresting data in detail have been published by Mons. M. L. ;* in regard to the cost of hoisting at several of the most t mines of Cornwall, England. He finds it to range from one ınd twopence to one shilling and elevenpence per ton for nging from 150 to 250 fathoms. Four examples are cited: Dol- ere the hoisting is by kibbles and chains in inclined and el- afts; United mines, where skips with flat ropes work in a ver- t; Levant, where skips, with flat and wire ropes, work in an haft; and Carnbrea, where kibbles, with chains and skips, with

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:traction dans les mines du Cornwall, etc., par M. L. Moissenet, Ingenieur Annales des Mines; II, 1862.

flat and wire ropes, work in various kinds of shafts. The particulars in each case extend over a period of twelve months, and tables are given for each mine, showing the quantity hoisted and the cost of materials used, not only in the shaft but at the engines, and in filling and landing.

From the various tables I have compiled the following, showing the mean depth, the quantity extracted in tons, the cost per ton, and the cost per ton per 100 metres at the four different mines.

Name of mine.	Mean depth.	Quantity extracted, tons.	Cost per ton.	Cost per ton per 100 metres
	Fathoms. Metres. *m.*	*Tons.*	*s. d. Francs.*	*Fr[illegible]*
Dolcoath	250 = 457.19	20,166	1 11 = 2.3981	0.522
United Mines	240 = 438.96	19,200	1 7 = 1.9440	0.448
Levant	190 = 350.00	16,800	1 2 = 1.4313	[illegible]
Carnbrea	150 = 274.00	36,000	1 6½ = 1.8857	[illegible]

At Dolcoath a little over 42 per cent. of the cost was in the shaft, 37 per cent. at the engine, and 21 per cent. (nearly) for filling and landing.

HOISTING MACHINERY IN CALIFORNIA AND NEVADA.

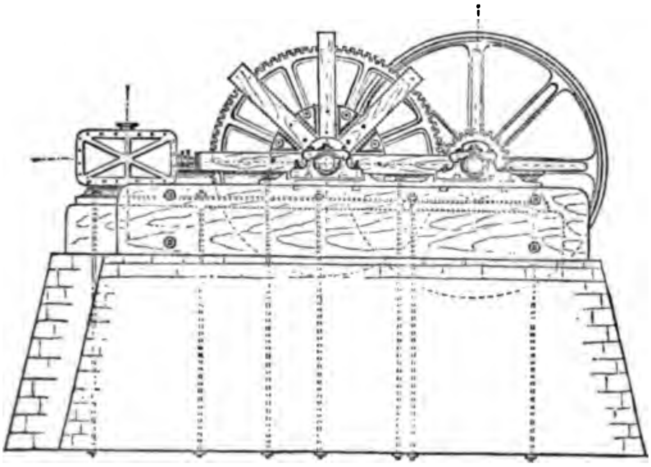
The simplest form of steam hoist, and the one usually employed in California and Nevada, for depths of a few hundred feet, especially if used in connection with pumps, is a steam engine with eight to ten inches diameter of cylinder and sixteen inches stroke, with or without link-motion to the valves, the engine only requiring to run one way. Upon the crank shaft is a pinion, grooved generally with a large V, the inner faces having an inclination toward each other of 60 to 90 degrees. This pinion gears by friction into a large V-wheel, proportioned to the size of the other, so as to hoist in the shaft from 200 to 300 feet per minute.

This large V-wheel usually forms one flange of the winding drum, and upon the opposite end of the drum is a second flange of the same diameter as the V-wheel, but with its periphery broadly recessed to receive a friction strap. The winding drum is made of boiler-iron, and is riveted securely to a projecting rim cast on the inner side of each of these wheels. The dimensions of this drum are usually 2 feet 6 inches diameter by 2 feet 6 inches long. The diameter of the large-friction V-wheel is 4 feet, and of the brake-wheel the same. The whole is keyed upon a shaft 3½ to 4 inches in diameter, and is mounted upon a wooden frame swinging upon a hinge. By means of a lever the large V-wheel is pressed firmly into contact with the fixed pinion on the engine shaft while hoisting. While lowering, it is thrown out of contact, and being perfectly detached from the engine, is free to unwind, its movement being controlled by the application of the friction band. The motion of the engine is controlled by the throttle-valve, and continues all the time in one direction, it being used only during the hoisting.

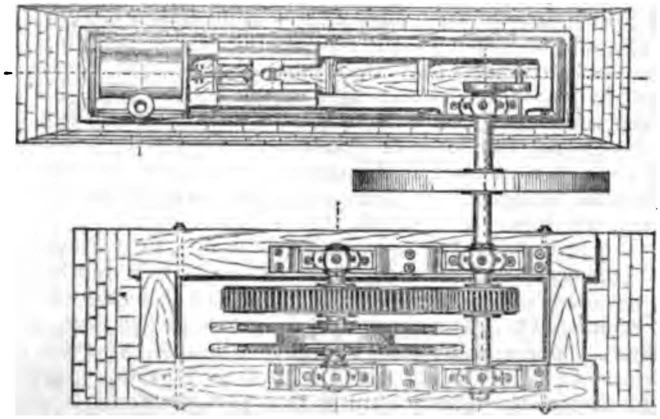
This construction for a hoisting engine is simple, durable, and comparatively safe for small loads and shafts that do not exceed two or three hundred feet in depth. For deeper mines and heavier work the drum-shaft is supported upon a frame which slides upon a secure bed, and can be pressed up to the V-pinion by levers, and the friction surface is increased by making several V-grooves instead of one, and giving them an acute angle. Where two or more shafts are to be worked a the same engine, a man is placed at each brake. Some engines 'e as many as four winding drums from one crank-shaft. One of the dvantages of this method is the unequal wear of the V-wheels, ch require turning off as often as twice a year, and sometimes once wo months.

oisting gear of the kind just described is manufactured by the on Iron Works. By means of long levers the engineer can control engine while standing at the mouth of the shaft. The piston of the ne has two-feet stroke, and the fly-wheel is eight feet in diameter. winding drum is three feet in diameter and three feet in length. construction is characterized by extreme simplicity and great igth.

nother form of hoist much in use for the mines of the west is the non link-motion engine, with a light fly-wheel fitted with a good



Booth & Co.'s Hoisting apparatus—elevation.



Booth & Co.'s Hoisting apparatus—plan.

, and a strong flanged pinion upon the end of the crank shaft. pinion gears into a spur-wheel, keyed upon the shaft of the wind- rum or reel. With this construction the engine and the winding drum can be turned either way, and if two skips or cages are worked at the same time and from the same level in the mine, the cables are wound so that one unwinds while the other is winding up, one thus balancing the other. But where the points of departure in the hoisting change, one reel or drum is made with a hub-flange or clutch, so that it can be easily adjusted to wind from a greater or less depth, as required. In mining requiring a sudden change of distance of hoisting, (from either an upper or a lower level,) each reel and wheel should run independently and have a separate friction band. The pinions on the crank-shaft are fitted with a clutch, which can be thrown in or out of gear when required to lower. The engine is under the control of one man, and each brake and reel under the control of another. When the bell strikes for either reel to hoist, the engine-man slows the engine to allow the clutch of the pinion to be put into gear. The brakeman then releases the brake and the hoisting commences. For stopping, the clutch is thrown out and the reel is held by the friction brake. In this way two or four shafts can be worked from one engine, and to any number of levels.

The above-described form of hoisting apparatus is illustrated by the annexed cut, giving a vertical and a side view of the machine with its foundation, as made by H. J. Booth & Co. It is here shown with a single bobbin for a flat cable; the spokes of this bobbin are of wood, and are not joined together by iron segments.

HOISTING AT THE MOUNT DIABLO COAL MINES.

At the Mount Diablo collieries the coal is hoisted in cars up a slope of 37° and 327 feet long, by an engine with a 14 by 30-inch cylinder. The crank-shaft carries a fly-wheel 12 feet in diameter, and a pinion 2 feet in diameter, geared into a spur-wheel 6 feet in diameter, which forms the end or flange of the winding drum. There are two drums, so connected by a clutch gearing that they can be easily disconnected at any time if desired. These drums are of iron, covered with wood, and are about 19 feet in circumference. A powerful brake, worked by the foot of the engineer, is fitted to the circumference of the fly-wheel, and is capable of stopping the engine very quickly. The engine makes 120 double strokes in a minute, and the usual time of hoisting a car carrying about one ton of coal is thirty seconds. Only one car is hoisted at one time, and about 200 are drawn up in the course of ten hours. But this is not the limit of the working capacity. As many as 270 have been taken out in that time, and the number could be exceeded if desired. Round iron wire rope, ¾ of an inch in diameter, is used, and passes over rollers about 3 feet in diameter. In some of the pits a flat wire rope, winding upon a reel, has been substituted.

At the Pacific Coal Mining Company's mines, near Mount Diablo, a very well constructed shaft was sunk vertically to a depth of 400 feet, and was provided with excellent hoisting works from the establishment of H. J. Booth & Co. The engine of 75-horse power was geared to a bobbin-shaft. There were two bobbins, winding inversely; flat iron cable, balanced; a link motion, and an ordinary brake, operated by the foot of the engineer. The pumping was performed by a separate engine of 150-horse power, 15-inch plungers, and a lift-pump.

HOISTING UPON THE COMSTOCK LODE.

Upon the Comstock lode, in Nevada, preference is given to one heavy, short-stroke engine, with balance valves and link motion; a pinion upon the crank-shaft; heavy spur-wheel, and flat winding cable.

The mines on the Comstock lode which have large hoisting works and wire cables include the Chollar-Potosi, Empire, Gould & Curry, Hale & Norcross, Imperial, Lady Bryan, Savage, and Sierra Nevada. An engine recently put up by the Risdon Iron and Locomotive Works, of San Francisco, has a 20-inch cylinder with 40-inch stroke, with 3 feet 6 inch pinion, 12-feet spur-wheel, 14-inch face by $3\frac{1}{2}$-inch pitch, a single winding reel for flat cable, 5 feet in diameter, sheave, or shaft pulley, 8 feet in diameter. With this it is intended to work from a depth of 2,000 feet.

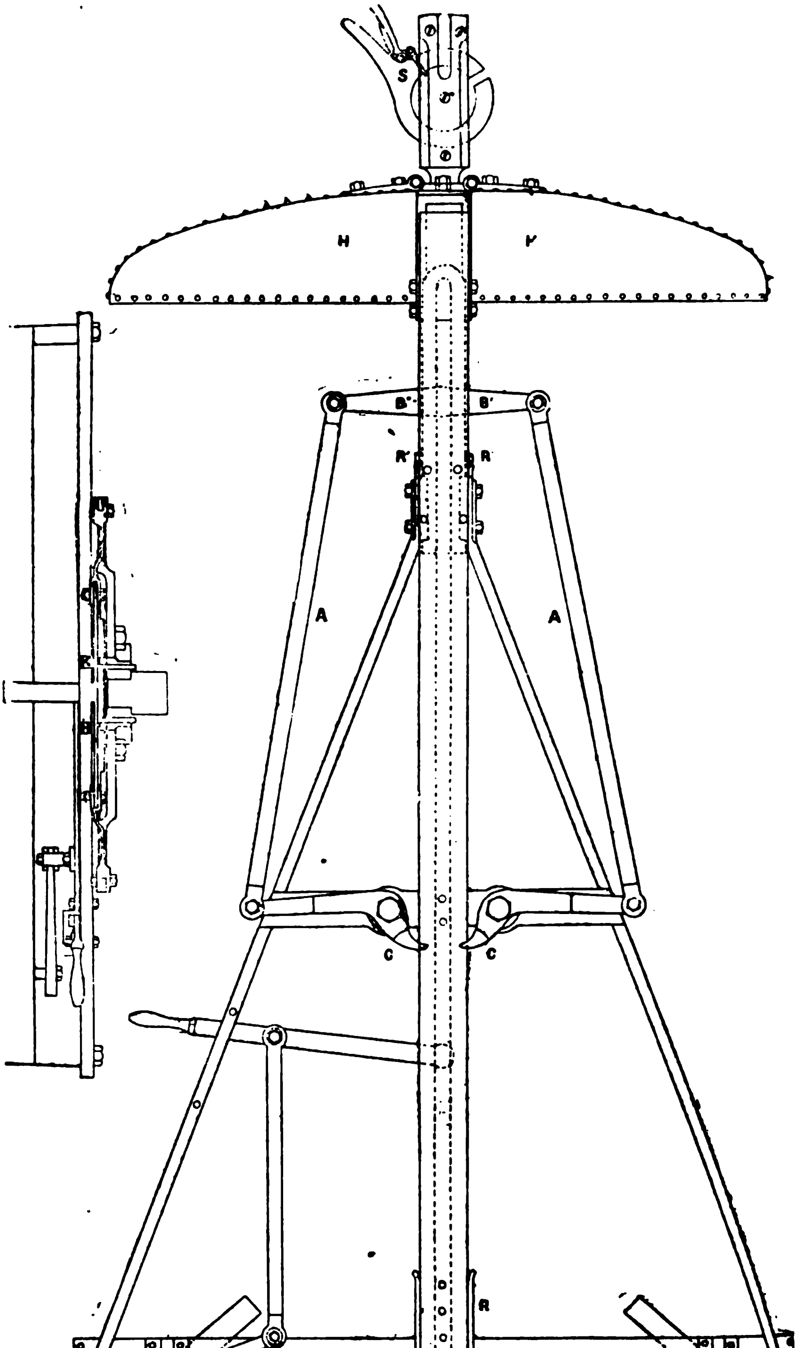
HOISTING IN GUIDED CAGES.

In each of the methods described the mineral, having been taken to the shaft, is either dumped in a pile and then shoveled into the bucket or skip, or is dumped through a chute directly into the skip, and the empty car is returned to the face. But this necessitates a rehandling of the mineral, which, when it reaches the surface, must be again dumped into a car or wagon, by which it can be delivered at the proper point away from the shaft.

These and other considerations have led to hoisting the car and load together to the mouth of the shaft. This effects a great saving in time, labor, and wear and tear of apparatus. It is the method adopted in the mines upon the Comstock lode, and in all well-appointed vertical shafts of any considerable depth elsewhere. To effect this, a compartment of the shaft is fitted with vertical stringers, or "guides" of wood or iron, extending from the top to the bottom, which serve to guide the movement of a platform cage, into which the car can be placed. The platform is fitted with rails of the same gauge as the track, and the car is rolled upon these and secured by bolts. The platform is a little smaller than the compartment of the shaft, and forms the bottom of a framework of iron, by which it is suspended. The frame rises above it on each side and connects with a cross-piece above the car, to which the hoisting cable is attached. The platform and the framework together form the "cage." By means of projecting ears or bars of iron or steel rubbers on each side, at the top and bottom, which partly embrace the guides, it is kept from contact with the sides of the shaft, and thus glides freely up and down. The only friction is between the rubbers and the guides, and this friction, in truly vertical shafts, is very slight. The shaft becomes, in fact, a vertical railway, and is a continuation of he tramways below, uniting them with the distributing tracks above. Tramming and hoisting thus become a connected and continuous operation. A carload of mineral is rolled to the bottom of the shaft and laced upon the platform, the signal is given to the engineman above, nd the load starts upon its vertical journey.

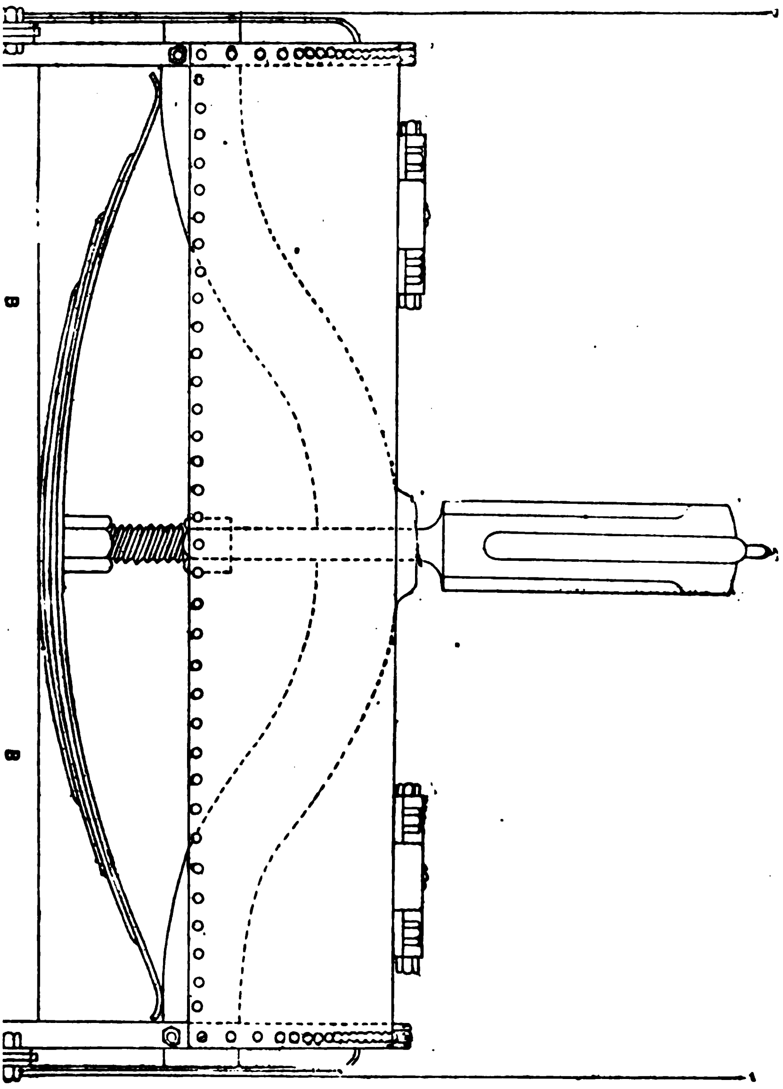
Most of the mines at Virginia City and Gold Hill, upon the Comstock ode, and in other parts of Nevada, and the principal deep mines in California, with vertical shafts, now use the cage. It is single, large nough for one car only, but the hoisting is very rapid, from 500 to 1,200 eet per minute, (8 ft. to 20 ft. per second,) and with heavy loads weighing from 5,000 to 8,000 pounds.

The construction of the cage, as I have remarked, is very simple, being usually a square plank platform with a track, upon which the car tands, and suspended by a kind of stirrup-frame of iron at each side to an arched cross-bar of iron at the top, through the center of which the od of suspension passes freely, and is firmly bolted just below to a



Side view and plan of one end of the Safety Cage in use in Nevada.

on cross-bar, free to move up and down in slots made in the
each side. This second cross-bar is connected at its two ends
on the outer side of the frame with the lever ends of dog-
safety catches. The construction will be more readily under-
eference to the figure, giving a side view of the most approved



the cage and catch, now in use in the mines of the Comstock
e platform P P is five feet long and three feet eight inches
is surmounted by a hood, H H, of boiler-iron, firmly secured

by hinges to the top of the frame, and designed to protect the miners from falling bodies. The height of the cage from the top of this hood to the bottom of the platform is eight feet. The ends of the rubbers are seen at R R and R′ R′; the clamps, or safety catches, at C C; and the arms A A, connecting these with a cross-piece above, B′ B′. A safety hook, S, for detaching the cage in case of overwinding, is placed at the top and turns in the head of the suspending rod. When the cage is at rest at the bottom of the shaft, or whenever it is not suspended by the winding cable, the cross bar B B, and cross-piece B′ B′, are pressed downward by a long and powerful steel plate spring, and this throws the points of the catches C C into the *sides* of the guide-timber, and not into the face, as is the case with Fontaine's and other safety catches. The construction of the upper part of the cage, including the spring and the suspension rod, is not shown in the side view of the cage, but will be seen in the second figure, giving a front view.

During hoisting or lowering the spring is compressed, and this serves to relieve the cage and load from the shock which attends a sudden commencement of hoisting.

The hand-lever just above the platform controls iron rods which rise through the floor of the cage and hold the cars securely in place during the ascent and descent of the cage.

The whole construction is light and simple, and has given general satisfaction. It is not closed in at the top and sides as closely as in the foreign mining cages, and is high enough to allow miners to stand upright as they ascend and descend. The hood is hinged to prevent the imprisonment of miners in case of accident, or drowning, if, as sometimes happens, the cage is lowered into water.

EUROPEAN GUIDED CAGES.

In Europe cages are made in a much more substantial and cumbrous manner, and they are generally arranged to receive several cars, either one above another upon separate platforms or, when the shaft is wide enough, two or three abreast. At Mons, in shaft No. 12 of Grand Hornu, eight wagons have been put into one cage of four stories. When the wagons are large, as, for example, those of twelve hectolitres at Blanzy, the cages are only two stories high.

They are usually made of iron, on account of both lightness and strength; and the angle irons and T-irons are found to be well adapted to the purpose. The cage of four stories was the form in use a few years since at Anzin. It is made of angle iron, strongly riveted, and weighs as follows:

	Kilogrammes.
Plate and angle irons	655
Sheet iron	220
Cast iron	32
The safety catch, (parachute)	218
Total weight of the cage	1,125

This cage will carry 2,000 kilogrammes of coal in the four wagons, which themselves weigh 720 kilogrammes, thus making the dead weight as much as 1,845 kilogrammes.

The cage used at Charleroi holds four wagons, like those at Anzin;

but they are here placed end to end upon two floors only, and the cage weighs 900, the four wagons 780, and the charge 1,600 kilogrammes.

At the Paris Exposition of 1867 Nicholas Libotte, constructor, of Silly, near Charleroi, exhibited some cages intended for the collieries of Charleroi, Belgium. These cages are remarkable for their extreme lightness and strength, and for the perfection of the forging. They are made of *steel*, are intended for a narrow shaft, and are capable of taking six wagons, one above another. The cage weighed as follows:

	Kilogrammes.
Cage	1,434
Parachute	128
Total	1,562

Another cage, similarly constructed, was made in two stages only, but was also designed to receive six wagons, three on each stage:

	Kilogrammes.
Weight of cage	1,268
Weight of parachute	164
Total	1,432

This cage was made for a shaft near Liege, Belgium.

In order to diminish the shock which results from the sudden descent of a cage upon the platform at the bottom of a shaft, especially when the cage is used for the descent of miners, caoutchouc springs have been placed under a false platform or landing, so as to prevent violent concussions when the motion of the cage is not sufficiently arrested in season to avoid a shock. So also, in order to avoid the sudden shock at the commencement of hoisting, spiral springs have been placed between the end of the cable and the top of the cage, so that the spring would be compressed before the cage began to move. But such springs require to be very strong and heavy to be of any service where such great weights are to be lifted; and this has led to the plan of placing large steel plate springs under the axle bearings of the great pulleys at the top of the shaft. But it is also desirable to have an elastic form of attachment to the cages; and this is secured to a certain extent by the use of the safety-catch, which requires a spring.

CABLES, WIRE ROPE, WINDING DRUMS, &c.

The leading mines upon the Comstock lode extend from 1,000 to 1,300 feet below the surface. In nearly every one the companies have changed their hoisting works several times, increasing their power and improving their construction to suit the increased duty of winding from constantly augmenting depths. Hemp cables have given way in part to round wire ropes, and these in turn to flat wire cables, some of them made of steel wire. The dimensions of these flat cables are 3 by ½ inch to 6 by 1½ inches for iron, and 2½ by ½ inch to 4 by ½ inch for steel. The length is usually 1,500 feet.

The manufacture of wire cordage and flat winding cables for mines is carried on in San Francisco upon an extensive scale at the works of A. S. Hallidie, erected in 1857. Their capacity of production is now over 1,200 tons of rope and cable annually. Their manufactures embrace every description of wire cordage, from the delicate bell and signal cord to those of a single piece 3,000 feet long and weighing nearly 40,000 pounds. Most of the hoisting works upon the Comstock lode have been supplied with winding cables from this establishment.

This firm has recently made a cable for the Imperial mine 1,600 feet long, 6 inches wide, and ½ inch thick, weighing 8,400 pounds. This cable is wound upon a 6-foot drum, but as generally several layers of the cable remain on the drum, not being unwound, the diameter is increased to 6½ to 7 feet. The sheaves for flat cables are usually only 7 feet in diameter, but this is too small; they should not be less than 12 feet.

DIAMETER OF WINDING DRUMS.

It is a common defect in all the hoisting works of California and Nevada that the winding drums and pulleys are too small. In Europe the diameter of winding drums has been greatly increased, and there are many examples of drums 20 feet in diameter. At the Casimir Perier colliery at Somain the round wire rope is used upon a drum with a diameter of 7m.14, or 25 feet. Twenty-five turns of this drum winds up 600 metres of cable. The weight of cable is four kilograms per metre.

These large drums are particularly desirable for wire ropes, which are destroyed very fast by a short bend. On these large cirumferences the turns are fewer, and the cable need not be coiled several times over itself, which causes great wear and destruction of the strands. Each turn of a drum 22 feet in diameter represents 66 feet of length of cable, and 25 rounds will reach 1,650 feet deep. With a rope one and a half inch thick the drum would have to be a little over three feet in length. In such a case the radius of the drum in winding would remain the same when wire rope is used; but this is not the case with hemp rope, which has a much greater diameter, and when winding up around the drum it must coil upon itself several times, and thus increase considerably the radius of the drum, and, on the other hand, in unwinding or lowering into the shaft the radius of the drum is rapidly reduced.

The difference of radius is insufficient to compensate for the weight of the unwound cable, and such an arrangement requires powerful engines to lift up the dead weight of cable at the start. From that moment less and less power is required until the two buckets or cages meet in the shaft; then the descending cable gradually takes the advantage of the ascending one, and the steam-engine, instead of driving, is soon driven with an increased velocity by the increasing weight of the descending cable. To avoid these inconveniences a system of counterpoises is used. Ropes carrying a counterpoise are wound around sheaves placed on the shaft of the drum; these counterpoises play up and down the shaft for about fifty or sixty metres; the cable unrolls as it goes down, and the radius of the sheaves diminishes. It is so arranged that when the entire cable is paid out and the counterpoise is down the two buckets or cages pass each other in the shaft. At that time the strain upon the hoisting drum changes, as also the action of the counterpoise. The rotary motion of the hoisting drum continues in the same direction, as also that of the sheave, which now winds up the rope of the counterpoise in the opposite direction. The force required to raise up this counterpoise counterbalances the weight of the descending cable. Another way, which gives better results, consists in using a very heavy cast-iron chain as a counterpoise.

M. Quillacq, a Belgian engineer, after having visited the hoisting works of England, and examined the system of counterpoises used there, proposed to place the winding bobbin directly over the shaft, and thus to dispense with the sheaves. Drums seven metres in diameter are placed on the top of the shaft, instead of the sheaves, and are driven directly by a double-cylinder engine. This system, which is fully described in "*Le Matériel des Houillères*," by Professor A. Burat, has not been entirely successful so far; but it has shown, however, that an economy of fifty per cent. can be realized on the wear and tear of cables.

Although difficult to do away entirely with the sheaves, it is quite easy to increase their diameter so as to avoid giving a short bend to the cables. It has been suggested that a series of rollers or small sheaves, placed on a curve of large radius, might advantageously be used instead of very large sheaves.

STEEL-WIRE CABLES—WEIGHT AND STRENGTH OF CABLES.

The use of cables made of steel-wire has been highly recommended on account of their superior strength and lightness. In practice abroad the high hopes entertained of the value of these cables have not been realized. The wire undergoes rapid changes, and has been found after five or six months' use to become brittle, so that the cable could no longer be relied upon. Some of the flat cables now in use in Nevada are made of steel; but no data regarding their weight and wear have been received.

The following table exhibits the size in inches of flat cables, their weight in pounds per fathom, their working load and breaking strain.* I have added also a valuable table which has recently been published, giving the comparative strength of iron, steel, copper, and hemp cables, expressed in dimensions and weights of the metric system.†

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* From Hunt's edition of Ure's Dictionary.

† From Etudes sur les Arts Textiles, &c., per Michel Alcan, p. 34.

Approximate dimensions, weight, and strength of round and flat cables of iron, steel, copper, and hemp.

ROUND CABLES.									FLAT CABLES.									STRANDS.								
	Iron.		Steel.		Copper.		Breaking strain of hemp cables of the same diameter.			Iron.		Steel		Copper.		Breaking strain and weight of hemp cables of the same dimensions.			Iron.		Steel.		Copper.		Breaking strain and weight of hemp strand of the same diameter.	
Diameter.	Weight per linear metre.	Breaking strain.	Weight per linear metre.	Breaking strain.	Weight per linear metre.	Breaking strain.	Breaking strain.	Weight.	Breadth and thickness.	Weight per linear metre.	Breaking strain.	Weight per linear metre.	Breaking strain.	Weight per linear metre.	Breaking strain.	Breaking strain.	Weight.	Diameter of the strand.	Weight per linear metre of each strand.	Breaking strain of each strand.	Weight per linear metre of each strand.	Breaking strain of each strand.	Weight per linear metre of each strand.	Breaking strain of each strand.	Breaking strain.	Weight.
m.	*k. g.*	*k*	*k. g.*	*k.*	*k. g.*	*k.*	*k.*	*k. g.*	*m.*	*k. g.*	*k.*	*k. g.*	*k.*	*k. g.*	*k.*	*k.*	*k. g.*	*m.*	*k. g.*	*k.*	*k. g.*	*k.*	*k. g.*	*k.*	*k.*	*k. g.*
0. 005	0. 072	502	0. 073	832	0. 082	420	70	0. 017	......	......	......	......	......	......	......	......	......	0. 0015	0. 011	82	0. 011	137	0. 012	69	8	0. 004
0. 0054	0. 104	724	0. 105	1, 199	0. 118	606	101	0. 025	0. 056	......	......	......	......	......	......	......	......	0. 0018	0. 016	119	0. 016	198	0. 018	99	12	0. 006
0. 0063	0. 142	985	0. 142	1, 631	0. 160	723	137	0. 034	0. 012	2. 603	17, 811	2. 613	29, 687	2. 962	14, 855	2, 710	0. 678	0. 0021	0. 021	161	0. 021	269	0. 024	135	15	0. 008
0. 0072	0. 185	1, 286	0. 186	2, 131	0. 210	1, 075	179	0. 045	0. 058	......	......	......	......	......	......	......	......	0. 0024	0. 028	211	0. 028	352	0. 032	176	20	0. 010
0. 0081	0. 234	1, 628	0. 235	2, 697	0. 265	1, 361	227	0. 057	0. 0125	3. 004	20, 266	3. 016	33, 778	3. 418	16, 889	2, 915	0. 734	0. 0027	0. 035	267	0. 035	445	0. 040	223	25	0. 012
0. 0090	0. 289	2, 010	0. 290	3, 330	0. 328	1, 680	280	0. 070	0. 063	......	......	......	......	......	......	......	......	0. 0030	0. 043	330	0. 043	550	0. 049	275	31	0. 015
0. 0099	0. 350	2, 432	0. 351	4, 029	0. 396	2, 033	339	0. 085	0. 013	3. 807	25, 650	3. 823	42, 751	4. 333	21 375	3, 548	0. 887	0. 0033	0. 052	399	0. 053	665	0. 060	333	38	0. 019
0. 0108	0. 417	2, 894	0. 418	4, 794	0. 472	2, 420	403	0. 101	0. 072	......	......	......	......	......	......	......	......	0. 0036	0. 062	475	0. 063	792	0. 071	396	45	0. 023
0. 0117	0. 489	3, 397	0. 491	5, 627	0. 566	2. 840	473	0. 118	0. 014	4. 711	31, 666	4. 729	52, 779	5. 362	26, 389	4, 466	1. 116	0. 0039	0. 073	557	0. 073	929	0. 083	464	52	0. 026
0. 0126	0. 567	3, 940	0. 569	6, 526	0. 642	3, 294	549	0. 137	0. 080	......	......	......	......	......	......	......	......	0. 0042	0. 085	646	0. 085	1, 077	0. 097	539	61	0. 030
0. 0135	0. 651	4, 423	0. 653	7, 492	0. 737	3, 784	630	0. 157	0. 016	5. 717	38, 316	5. 739	63, 862	6. 508	31, 931	5, 667	1. 417	0. 0045	0. 097	742	0. 098	1, 237	0. 111	619	70	0. 035
0. 0144	0. 741	5, 146	0. 743	8, 524	0. 839	4, 302	717	0. 179	0. 085	......	......	......	......	......	......	......	......	0. 0048	0. 111	844	0. 111	1, 407	0. 126	704	80	0. 040
0. 0162	0. 938	6, 513	0. 941	10, 788	1. 062	5, 445	907	0. 227	0·017	6. 877	45, 600	6. 903	76, 001	7. 831	38, 001	6. 373	1. 593	0. 0054	0. 140	1, 069	0. 141	1, 781	0. 160	891	101	0. 050
0. 0180	1. 158	8, 041	1. 162	13, 319	1. 311	6, 722	1, 121	0. 280	0. 098	......	......	......	......	......	......	......	......	0. 0060	0. 173	1, 319	0. 174	2, 199	0. 198	1, 099	124	0. 062
0. 0198	1. 401	9, 729	1. 406	16, 116	1. 586	8, 133	1, 355	0. 339	0. 019	8. 735	57, 713	8. 768	96, 187	9. 942	48, 094	8, 193	2. 048	0. 0066	0. 210	1, 596	0. 211	2, 661	0. 239	1, 330	150	0. 075
0. 0216	1. 667	11, 579	1. 673	19, 179	1. 888	9, 679	1, 612	0. 403	0. 108	......	......	......	......	......	......	......	......	0. 0072	0. 250	1, 900	0. 251	3, 167	0. 285	1, 583	179	0. 089
0. 0243	2. 110	14, 655	2. 117	24, 274	2. 389	12, 250	2, 041	0. 510	0. 0215	10. 888	71, 250	10. 930	118, 752	12. 393	59, 376	10, 165	2. 566	0. 0081	0. 316	2, 405	0. 317	4, 008	0. 360	2, 004	227	0. 113
0. 0270	2. 605	18, 092	2. 614	29, 968	2. 950	15, 124	2, 519	0. 630	0. 121	......	......	......	......	......	......	......	......	0. 0090	0. 390	2, 969	0. 392	4, 948	0. 445	2, 474	280	0. 140
0. 0306	3. 345	23, 239	3. 358	38, 492	3. 789	19, 426	3, 226	0. 809	0. 0235	14. 098	91, 518	14. 152	152, 530	16. 047	76, 265	12, 511	3. 128	0. 0102	0. 501	3, 813	0. 503	6, 356	0. 571	3, 178	359	0. 180
0. 0351	4. 402	30, 576	4. 418	50, 646	4. 985	25, 559	4, 257	1. 064	......	......	......	......	......	......	......	......	......	0. 0117	0. 659	5, 017	0. 662	8, 362	0. 752	4, 181	433	0. 236
0. 0396	5. 603	38, 919	5. 623	64, 464	6. 346	32, 533	5, 419	1. 355	......	......	......	......	......	......	......	......	......	0. 0132	0. 839	6, 386	0. 842	10, 644	0. 957	5, 322	602	0. 301
0. 0441	6. 948	48, 267	6. 974	79, 948	7. 870	40, 347	6, 721	1. 680	......	......	......	......	......	......	......	......	......	0. 0147	1. 041	7, 920	1. 045	13, 200	1. 187	6, 600	747	0. 373
0. 0486	8. 439	58, 620	8. 470	97, 096	9. 558	49, 001	8, 162	2. 040	......	......	......	......	......	......	......	......	......	0. 0162	1. 264	9, 619	1. 269	16, 031	1. 441	8, 016	907	0. 453
0. 0531	10. 074	69, 979	10. 111	115, 909	11. 410	58, 496	9, 744	2. 436	......	......	......	......	......	......	......	......	......	0. 0177	1. 509	11, 483	1. 515	19, 138	1. 720	9, 569	1, 083	0. 541

The dimensions in this table are stated in fractions of a metre; the weights in kilogrammes and grammes, and the breaking strain in kilogrammes.

ble showing the size, weight, and strength of flat cables for mining purposes of hemp, iron, and steel.

HEMP.		IRON.		STEEL.		EQUIVALENT STRENGTH.	
Size in inches.	Pounds weight per fathom.	Size in inches.	Pounds weight per fathom.	Size in inches.	Pounds weight per fathom.	Working load.	Breaking strain.
						Cwt.	*Tons.*
4 by 1¼	20	2¼ by ½	11	....	....	44	20
5 by 1⅜	24	2½ by —	13	....	....	52	23
5½ by 1½	26	2¾ by ⅝	15	....	....	60	27
5¾ by 1⅝	28	3 by —	16	2 by ½	10	64	28
6 by 1¾	30	3¼ by —	18	2¼ by ½	11	72	32
7 by 1⅞	36	3½ by —	20	— by —	12	80	36
8¼ by 2¼	40	3¾ by 11-16	22	2½ by ⅝	13	88	40
8½ by 2½	45	4 by —	25	2¾ by ⅝	15	110	45
9 by 2⅝	50	4¼ by ¾	28	3 by —	16	112	50
9½ by 2¾	55	4½ by —	32	3¼ by —	18	128	56
10 by 2¼	60	4¾ by —	34	3½ by —	20	136	60

PRECAUTIONS IN USING WIRE-ROPE.

In winding with round wire rope upon conical drums, it is important make sure that the angle of inclination of the surface of the drum is ot too great, as otherwise the coils of the rope are apt to slip off and use serious accidents. Several fatal accidents have occurred in Eng-nd from this cause. They are mentioned beyond in connection with e notice of the various forms of safety cages. Mr. Wales, a govern-ent mining inspector, (Great Britain,) in his examination upon the use of one of the accidents referred to, said:

“ In his opinion, what most affected the proper and safe working of e spiral drum was the angle which the rope formed between the pulley er the shaft and certain portions of the drum. In the present case e angle was fifteen degrees, and in his opinion the accident was prin-pally due to that fact, and not to any defect in the rope, which was oken by the jerk caused by the rope falling from the drum. In con-usion he remarked that in erecting spiral drums care should be taken have the rope at as easy an angle as possible, and in no case ought it exceed from ten to eleven degrees.”

Professor Warrington Smyth, of the British Royal School of Mines, one of his lectures directs attention to the precautions necessary in e use of conical drums. He mentions the case of a very serious ac-dent a few years ago, by which the lives of a number of men were crificed, simply, he believes, in consequence of the cage having been ound up at too great a velocity, and then allowed to slacken too sud-enly, the result being that the laps got loose, some part slipped off, e rope went over the edge of the drum, and was snapped. Mr. myth then points out how this danger may be obviated by an ingen-us contrivance of M. Lemielle, which consists of an endless rope passed own the shaft, and over a pulley at each extremity. The rope is thus ept constantly stretched out, and motion is communicated to it by a irect-acting cylinder, which sets one of the pulleys in motion.

It is found to be very dangerous to allow wire ropes to wind over y inequality or projection by which the wires are subjected to repeated ending back and forth. At the Cannock Chase Colliery, England, 1867, the flat-wire cable suddenly snapped and precipitated eight en and boys to the bottom of the shaft, killing five. The inspector und that at the point of fracture the cable had been covered for about eighteen inches with hemp, which had become hard and solid, an formed a bolster or projection on both sides of the cable, three-fourth of an inch thick. The object of placing this hemp upon the cable wa to show the engine man when the cage was opposite a certain drift, wher it had to stop. In passing to and fro over a pulley five feet in diamete and under a drum of the same diameter, the constant bending broke o the wires. This effect was probably gradual, since it appeared on examination that only twenty-five or twenty-six wires, one-seventh of th number in the cable, were whole when the cable finally parted. Th covering also prevented the condition of the cable from being known and it was believed that the breaking of the wires had been going on fo three weeks or a month before the accident.

EXAMPLES OF HOISTING WORKS ABROAD.

As the depth of our mines increases the importance of improving ou hoisting works becomes more and more apparent, and it will, therefore be appropriate to notice in detail some of the best specimens of hoistin engines now in use abroad, particularly at the collieries of Belgium France, and Great Britain, where we find the most perfect types and exhibitions of mining upon the most extended scale. At present ou best hoisting works are only approximations in construction and in magnitude to those abroad. The extent of our mines has not required us to carry our machinery to such a degree of perfection; but the day is not distant when for the Comstock lode alone we shall not only have to avail ourselves of the fruits of experience in deep mining in foreign countries, but even to improve upon their most admirable and beautiful machines.

There is nothing to prevent, indeed there is much to encourage, us to push our explorations of the Comstock lode to a depth of 3,000 feet or more; and for this purpose very powerful engines and hoisting apparatus will be required. The wise provision which should characterize all large undertakings, especially in mining, requires us to take this subject into careful consideration. The engineers of Belgium and France have for some years past been discussing the best methods of carrying the exploitation of their coal beds to a depth of at least 1,000 metres; and some of the opinions expressed upon this subject will be mentioned at the close of this division of the report, after some details concerning the existing conditions of hoisting have been given.

There are two principal types of hoisting apparatus: the single engine, acting upon the drum or bobbin-shaft, through the medium o gearing, and the double engine, acting directly upon the bobbin-shaft b cranks set at right angles with each other. Of these two types, th double direct-acting engines are preferred for large collieries, wher rapid hoisting is essential.

Professor Burat, in remarking upon the use of engines acting directl upon the shaft of the winding drum, states substantially that wheneve the conditions of hoisting do not require a greater force than 80 horse-power, gearing should be used; and that the direct-acting engines wit two cylinders should actually exert at least 100 horse-power. If th cages are not required to move with a velocity of at least four to fiv metres a second the gearing is evidently preferable to placing the winding drums upon the crank-shaft. This opinion is confirmed by comparisons between the consumption of coal in hoisting works upon the tw plans, which are in favor of the machines with gearing. For hoisting wit great rapidity, the direct-acting machines are the best, and are no generally used.

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Many establishments, and especially those of Haine-Saint Pierre, of Couillet, and of Seriang, in Belgium, and of Quillacq, at Anzin, have produced hoisting apparatus of this type which appear to leave little to be desired. Such machines are made either vertical or horizontal. In the former the winding reels are raised high in the air, and the only advantage appears to be that the inclination of the cable is lessened, so that the angle it makes with the surface of the sheave is increased. A disadvantage is the instability of the machine, owing to the little breadth of foundation, and to its great height. The horizontal engines are much more firm and substantial.

The accompanying illustration, printed upon a separate sheet and inserted, (page 584 A,) represents an engine of Quillacq's construction of the vertical type. This figure is reduced by Bien's photo-relief process from one of the beautifully engraved plates in Burat's Atlas. It does not require much explanation. One cylinder is shown in section with the piston at the lower end. The brake-wheel is between the two bobbins. The engineer stands upon an elevated platform on a level with the bobbin-shaft, and controls the valves by means of levers. Three inches and three-eighths of an inch upon this reduced drawing represents a distance of about five metres.

In all of these modern engines a very great improvement has been made y the addition of a powerful brake, worked by steam. Instead of the ttendant exerting a large part of his strength upon the lever of a brake, is now only necessary for him to open a valve by a hand lever, and hus admit steam to one side of a piston in a short cylinder, and the rake is instantly applied with greater force than a man could possibly xert. For such powerful engines as are now in use, and worked as hey are at a high rate of speed, a brake of this kind is indispensable.

Mr. Quillacq, constructing mechanical engineer at Anzin, appears to ave been a pioneer in the construction of large direct-acting double oisting engines. He published a description of one of these engines in 859.*

The cylinders were each 0^m.600 in diameter, and the pistons had stroke of 1^m.800; bobbin-shaft 3^m.400 long and 0^m.290 in diameter; wo bobbins 6^m.500 in diameter; Stephenson slide motion; a steam rake, with the cylinder 0^m.350 in diameter, drawing the two brakes of ood powerfully upon the periphery of a wheel 3^m.300 in diameter. his machine was provided with signal indicators, and apparatus for resting the motion of the engines and cages after the cages passed a rtain point above the mouth of the shaft. The whole machine, with ed-pumps and fixtures, weighed 42,000 kilogrammes and cost less than ,000 francs.

The same constructor exhibited a very beautiful hoisting apparatus the Paris Exposition in 1867. It was a double engine of about 200 rse-power. The cylinders were vertical and connected directly with e bobbin-shaft, supported high in the air above the engines. Cylin- rs about 3 feet in diameter and 6 feet stroke. Link motion upon th. Bobbins for flat wire or hemp cable, and 22 feet in diameter. eam brake, signal indicators, and apparatus for preventing overwind- g were all included in this beautiful machine, for 38,000 francs. It pears from a bulletin that from 1856 to March, 1867, inclusive, the m had supplied 67 machines of 7,012 horse-power in the aggregate, rying from 6 to 500 horse-power, the latter for pumping.

In a machine exhibited by A. Audry, engineer of the establishment Mr. F. Dorzee, near Mons, the bobbin-shaft is placed below on a level with the floor, and the cylinders rise vertically above it and act downward, instead of upward, as in the engine by Quillacq. The cylinders of this machine are $0^{m}.90$ in diameter and the stroke $1^{m}.40$. Five machines have been made upon this model at different times from 1853 to 1867, varying in capacity from 80 to 150 horse-power.

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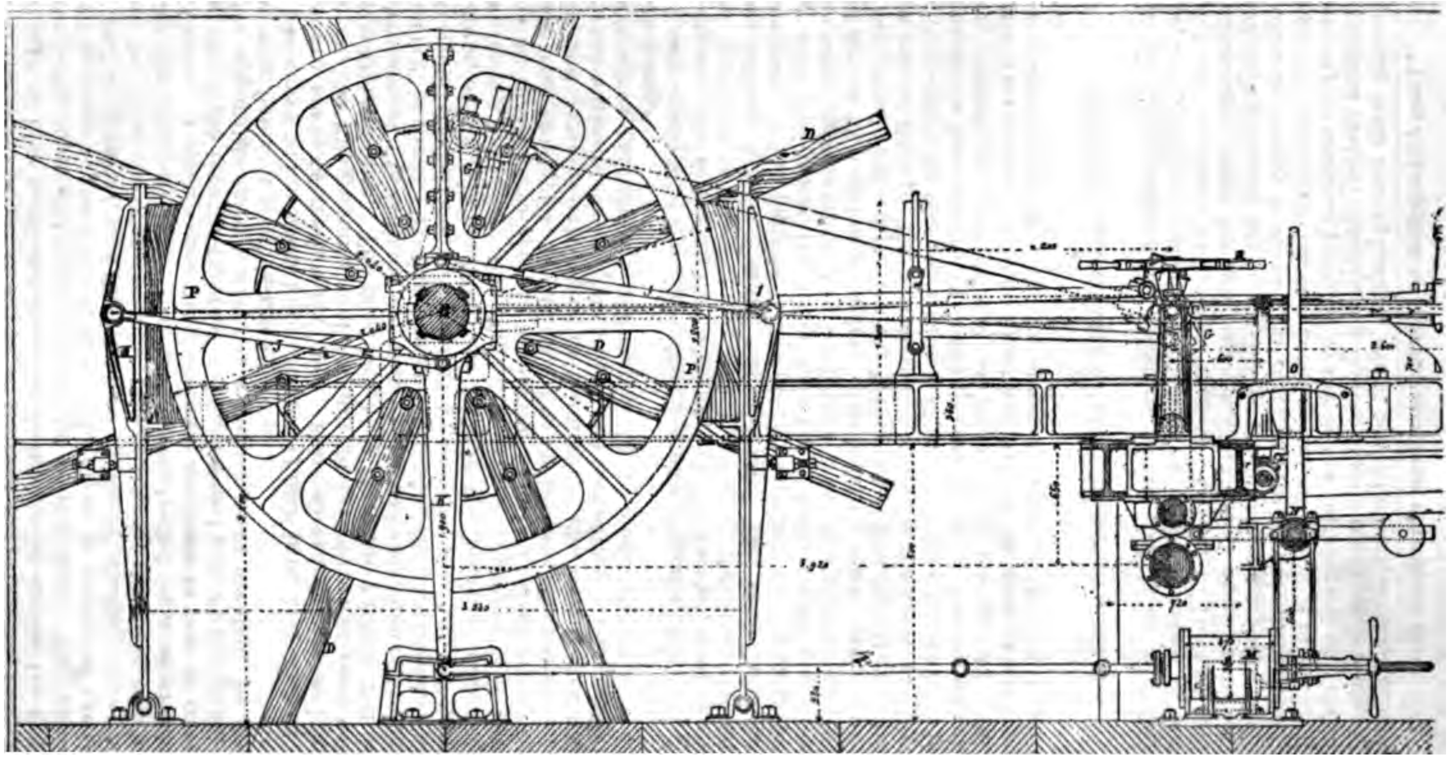
* Annales des Mines.

A very beautiful machine of the direct-acting horizontal type was exhibited at Paris in 1867, by the establishment of M. M. Schneider & Co., of Creuzot. Its strength, proportions, and convenient arrangement of the various parts were admirable. The cylinders, 2^{m} long and $0^{m}.550$ in diameter, are placed $5^{m}.60$ apart, from centre to centre. The rods are connected directly with cranks of 1^{m}, placed at right angles upon the opposite ends of a main shaft, $0^{m}.3$ in diameter, which carries the two bobbins and the friction-wheel, to which the brakes are applied by means of steam, acting upon a piston in a small cylinder below the floor of the engine-room. The diameter of this wheel is 3^{m}, and the length of each of the two wooden blocks which bear upon its periphery is $1^{m}.2$. The diameter of the drum of the bobbins is $2^{m}.04$, and total diameter along the arms is about $5^{m}.5$. The arms of the bobbins are of wood, and the extremities are not connected by segments, as in many of the Belgian and French machines. The length of the lever controlling the brakes is $1^{m}.9$, the diameter of the cylinder $0^{m}.34$, the length $0^{m}.47$.

The engineer stands midway between the forward ends of the cylinders, with both the bobbins in full view, and by means of conveniently placed levers and hand-wheels controls the movements of the engine and the operation of the steam-brake.

The details of construction of a portion of this engine are shown by the accompanying figure, reduced by the photo-relief process from the larger working drawings published in the *Portefeuille des Ingénieurs*, by the Messrs. Armengaud. The figure gives a longitudinal elevation of the bobbin, the brake-wheel, and brakes, together with the steam cylinder for operating the brake, and the levers by which the engineer controls the movements of the engine. The cylinders of the horizontal engines and their valves are not shown. B is the bobbin-shaft, carrying the bobbin with wooden spokes D D D and a cast-iron brake-wheel P P. The spokes, eight in number, are not united by segmental rims at their extremities, as in some machines, but are disconnected, the cable winding truly between the two opposite sets of spokes without catching upon their ends. These spokes are firmly bolted by their inner ends to a cast-iron socket plate, $2^{m}.040$ in diameter. This plate and the brake-wheel P P are securely keyed to the shaft B. An arm, K, $1^{m}.90$ in length, works loosely upon the shaft B, and by means of the connecting rods J J controls the brake pieces I I, faced with blocks of wood $1^{m}.20$ long, which fit into the hollow face of the brake-wheel P P. The brake-pieces, as will be seen, are supported in an upright position $3^{m}.230$ apart by the prolongation of their frames to the foundation below, to which they are united by hinge joints. The undue separation of these brake-pieces is prevented by set screws placed behind each, and their approximation and pressure upon the brake-wheel is controlled by means of the rod K extending from the end of the arm K to the steam cylinder M. By means of the hand-lever O N steam can be instantly admitted to one side or the other of the piston in M, and thus operate the brakes with great force.

The engineer stands upon a platform just above the steam cylinder M, and controls the link-motion by means of the horizontal hand-wheel R. The dimensions and distances of the most important parts are indicated upon the figure in metres and in fractions of a metre.



hoisting-engine, if the necessary apparatus for changing the direction of rotation were supplied.

It is an interesting fact that English colliery owners find it for their advantage to contract for their hoisting-engines and machinery with the French constructor Quillacq, at Anzin. This eminent maker astonished the British members of the international jury by the statement that he had supplied both pumping and winding engines to an important Newcastle colliery. It is admitted by the British reporter upon that class in the exposition, that the order was given to the French manufacturer simply in consequence of his lower price and better finish, as compared with the tenders from English houses; and he observes: "Here we have, then, one of our Newcastle mines actually working by means of French-made machinery, fairly brought in, by open competition, to the midst of our machine shops and foundries; and when we look at the inland position of Anzin, and the unquestionable disadvantages which have to be combatted in a district where coal and iron are comparatively dear, I cannot but think these results redound to the credit of French engineering, and inculcate on ourselves an important lesson."

Opinions upon the relative value of the two methods of mounting hoisting works, whether they should be vertical or horizontal, are still divided. The English generally prefer the vertical form. There is not only the advantage in regard to the inclination of the cables upon the pulleys, a very considerable advantage when one of the cables is wound on the lower surface of the bobbin, but the engineer can be placed much nearer to the landing-place of the cages, and thus, having their movements directly under his eye, will avoid many accidents that would otherwise happen, notwithstanding any system of signals. It has been supposed that the vertical machines are much more costly than the horizontal; but M. Parent, director of the Anzin works, who has used both, holds an opposite opinion. There is so much doubt in regard to this matter that the Anzin company, having two shafts to provide with hoisting works, decided, in 1868, to place a vertical engine over one shaft, (Haveluy,) and a horizontal one over the other, (St. Mark.) The question of the relative advantages is still undecided; but it is agreed that in all cases it is best to place the engineer as near to the landing of the cages as possible; and to secure this, the position of the horizontal engine has been changed. The engine has been turned end for end, so as to place the cylinders toward the shaft, and bring the engineer within five or six metres of it.

In order further to illustrate the general form of large hoisting works abroad, one of the engraved plates in Burat's Atlas has been reduced, and is printed upon a separate sheet to accompany this chapter. It represents the construction at the colliery of Bezenet, and shows not only the large derrick supporting the great pulleys over the shaft, but the two-story iron cages, the cars, and the arrangement for automatic lowering of the loaded cars to a track upon the general level while the empty cars are hoisted. The engine-house and engine, with the large bobbin for flat cable is seen at the right-hand end of the plate. A rod with an ram projecting over the cage is so arranged as to stop the engine in case of over-winding. The boilers are set outside of the building upon the extreme right.

HOISTING FROM GREAT DEPTHS.

The Academy of Sciences of Brussels in 1856 proposed the subjoined question for discussion, and the minister of public works offered a special prize for a satisfactory answer: [Translation.] "Indicate a complete practicable method for extending the exploitation of collieries to a depth of at least 1,000 metres, without sensibly increasing the cost of working beyond that in Belgium at the present time."

Among the most remarkable of the memoirs presented was that of M. Devillez, professor of mechanics at the school of mines of Hainault. He concludes that, without any new invention, but with a judicious use of the best means of exploitation then employed, it was quite possible to succeed in working at such great depths. He proposes to use, instead of hemp, flat cables of iron wire, weighing, on an average, $7^{k}.33$ per running metre, or a total for each of 733 kilogrammes. Cables of the same length of hemp would weigh more than 9,000 kilogrammes. With such wire cables, he could raise, at a mean velocity of six metres per second eight wagons containing together 2,700 kilogrammes of coal. The dead-weight of the cage and wagons would reach 2,150 kilogrammes. The whole could be brought to the surface in three or four minutes, and he thinks that a 200 horse-power engine would be sufficient for the service. The initial radius of the bobbins, according to calculation, should be $0^{m}.72$ for tapering cables of iron wire and $1^{m}.00$ for those made of hemp.

Another method proposed for hoisting from great depths, and already put to a test in practice, deserves mention. It is the contrivance of the engineer, M. Mehu, and was experimented with in one of the shafts at Anzin. It consists of two vertical oscillating rods moving up and down in the shaft, as in the man engine, and attached to the extremities of a hydraulic balance. One rod raised the full wagons, and the other carried down the empty wagons. But after being tried successively at the mines of Anzin and of Bonchamp it has been abandoned.

TURNING OR STARTING GEAR.

An apparatus has recently been constructed and applied in England for rendering uniform the driving power of single cylinder steam-engines used for winding or other purposes. It is well known that the driving power of single engines is far from being uniform throughout the revolutions of the crank. At the end of the stroke dead-centers exist, and there is no tangential pressure at all; and from these points the pressure upon the crank pin in the direction of its motion gradually reaches a maximum at about the middle part of the stroke, and as gradually diminishes to nothing. The object of the apparatus, which the inventors* call "turning-gear," is to enable single engines to be started, reversed, or to work with the facility and regularity of double engines, with their cranks at right angles to each other. The advantages claimed for the apparatus over double engines are its great cheapness and the possibility of its application to existing engines as well as to new ones. It consists of a small supplemental oscillating steam cylinder, placed below and a little back of the main crank, and connected with it by the middle of a jointed connecting rod, one end of which turns upon a fixed bearing in the foundation. A toggle-joint is thus formed, and the piston connects at the joint. This toggle is so placed as to operate tangentially upon the crank when near its dead-points. The inventor claims that by such means the engine possesses equal driving power during every part of the crank's revolution, so that upon the dead-centers all the work is done by the turning gear, but during the rest of the revolution it is done by the crank alone, or in combination with the turning gear. With this transfer of pressure from one part of the revolution to another no steam is consumed; there is no loss of power, except the mere friction of the apparatus; neither is there any direct gain.

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* William Macgeorge, London, and Arthur Rigg, Chester.

He says:

> For winding purposes at collieries or mines, single engines are objectionable, although frequently used, and double engines are preferable on account of their handiness and safety from overwinding and the uniformity of their power at every part of their revolution. Now, as this turning gear gives to single engines all the advantages belonging to double engines, there is manifestly a saving in first cost, and to this must be added less expensive foundations and a smaller engine-house. It is equally applicable wherever the use of a fly-wheel is inconvenient, and has been applied to a compound marine screw engine of 100-horse power. With its use there is not the slightest hesitation or uncertainty in starting or reversing, and the engine can either revolve at full speed or be made to crawl slowly round, with the regularity of clock-work. It would be almost superfluous to point out the peculiar advantages of this latter capability in doing pit work at collieries.

The inventor claims to accomplish the same result for engines which revolve in one direction only, by placing a large double cam upon the end of the crank shaft, in such a position with respect to the position of the crank that it is acted upon by a roller forming the head of a short piston, working in a cylinder directly under the shaft. This is a very simple and cheap form and can be applied to any engine. Drawings of this apparatus accompany the Colliery Guardian for January 28, 1870.

CHAPTER LXXIII.

SAFETY-CATCHES, OR PARACHUTES.

The great depths to which mining operations are now carried; the increased rapidity of movement of the cages, (often as great as thirty and forty feet in a second,) and the paramount obligation to protect the lives of the miners who often ascend and descend by the cages, has led to the adoption of a variety of contrivances for arresting the fall of cages in the event of the breakage of the cables by which they are suspended. Such contrivances are known as *parachutes* or safety catches.

The great velocity of hoisting requires the cages to be guided in the shafts by vertical tracks, which are commonly constructed of wood, though of late they are being replaced by iron and steel; these tracks, called *guides*, being continuous and equidistant along the path of the cage, furnish a foundation upon which the various parachutes can act to sustain the cage in the event of breakage.

A large number of patents relating to this important and indispensable apparatus have been taken out, but it may be said that there are only three types, and that these originate from the same principle—levers drawn up and away from the guide by the traction of the cable, and in an opposite direction by the tension of a spring which tends to throw the levers outward upon the guides, so as to press upon or into them with a force capable of stopping the fall of the cage in case of the rupture of the cable.

One of the forms of safety catch now in use in the Savage silver mine upon the Comstock lode has already been described and shown by a figure in connection with the description of the ordinary form of cage. This description and figures will be found upon pages 576, and 571.

In 1845 M. Machecourt published a description of a parachute which he had applied to the cages in the shaft of a coal mine at Decize. This parachute consisted of two pointed bars or arms of iron crossed and turning upon a rod like the two blades of a pair of shears. While the cage remained suspended by the cable the points of these arms were drawn inward, away from the sides of the shaft, but in the event of the rupture of the cable, the arms were thrown outward and downward by springs, and penetrating the timbers of the shaft, held the cage suspended.

In 1849 M. Fontaine, of Anzin, constructed a parachute for the Tinchon shaft upon this principle, but in a better form, and at the time of the publication of Professor Burat's Matériel des Houillères, in 1861, the form most in favor and indeed the only form with which sufficient experience had been acquired to justify a recommendation of its general use, was the Fontaine parachute, then in use in more than fifty shafts in France and Belgium. It is considered as having originated with the Anzin company, and owes its introduction and success to the careful attention with which all its details were studied and modified by long experience.

All parachutes combined and constructed on this principle have given satisfactory results, and it may be said that, if the security obtained is not complete and absolute, they have, nevertheless, rendered such great services that their application has become a question of humanity, which cannot be ignored. The following figures will speak in a stronger and more peremptory manner than any description to persuade miners and engineers to adopt parachutes in their mines. At the mines of Anzin, from 1851 to 1859, in fourteen shafts supplied with parachutes, twenty-nine cable ruptures occurred, and the parachutes saved the lives of one hundred and fifty men. What can be more eloquent and more persuasive than this fact?

At the mines of Blanzy the experience has been similar, and it is probable that if an account had been taken of all the accidents by the rupture of cables in Europe since parachutes came into use, it would show that the men who have been saved from certain death by parachutes can be numbered by thousands.

In order that a parachute should act well, it is necessary that the strength of the spring should be equal to 150 kilogrammes, (300 pounds,) and then the weight of the cage makes the rest; and the heavier that weight the more energetic is the grasp on the guides.

The three types are—

1. *The parachute with claws*, which acts by a pressure exerted upon the guides tending to penetrate them longitudinally.

2. *The parachute with eccentrics*, which acts by a pressure exerted laterally on the sides of the guides, and perpendicularly to the plane which passes through both of their axes.

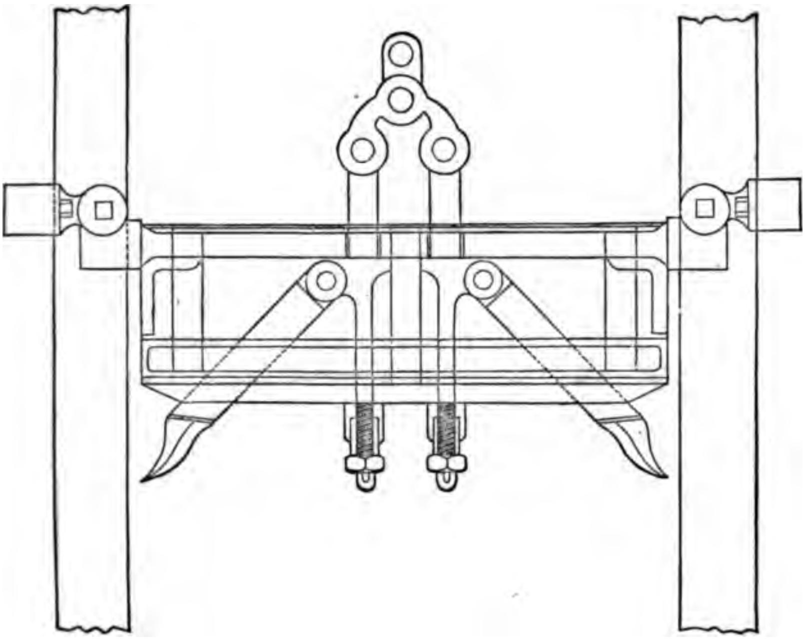
3. *The wedge parachute*, which acts by means of a set of metallic jaws taking hold of the guide, which is made wedge-shaped. This parachute gives a lateral pressure exercised upon the faces of each guide, and perpendicularly to the plane of the parachute.

These several types will be considered one after the other.

FONTAINE'S CLAW PARACHUTE.

The annexed figure represents Fontaine's parachute with claws. It is the oldest, and was constructed and put in use at the mines of Anzin, and may be said to have originated with this company. At first this parachute was supplied with only one spring, but two are now used, as shown by the drawing. It was the type exhibited upon the two-story cage sent by the company of Anzin to the Paris Exposition, in 1867.

The two stout diagonally placed arms in the drawing are armed with sharp steel points, and are so placed in the frame of the head of the cage that when it is suspended in the shaft by the cable, these claws are drawn up so as not to touch the guides. Two strong, spiral springs, replaced in some parachutes by steel elliptic springs, are placed below, and in the event of the breaking of the cable they draw down the upper ends of the claws, and the lower and steel-armed ends are forced outward into contact with the wooden guides, penetrating and sometimes splitting them. The cage is thus arrested in its fall, and is sustained entirely by the wedging of these claws against the guides and timbers of the shaft. Each claw can work independently, the double hook at the top permitting either one or both to be thrown out together or to different distances, so that inequalities in the size of the shaft or of the distance between the guides may not prevent a perfect contact of both arms. The projections beyond the guides upon each side are intended to represent a part of the framework at a point where the guides are perforated for the reception of a bolt intended to prevent the cage from being hoisted prematurely. This is a contrivance introduced by the engineer Cabany, and is placed at the bottom of the shaft.

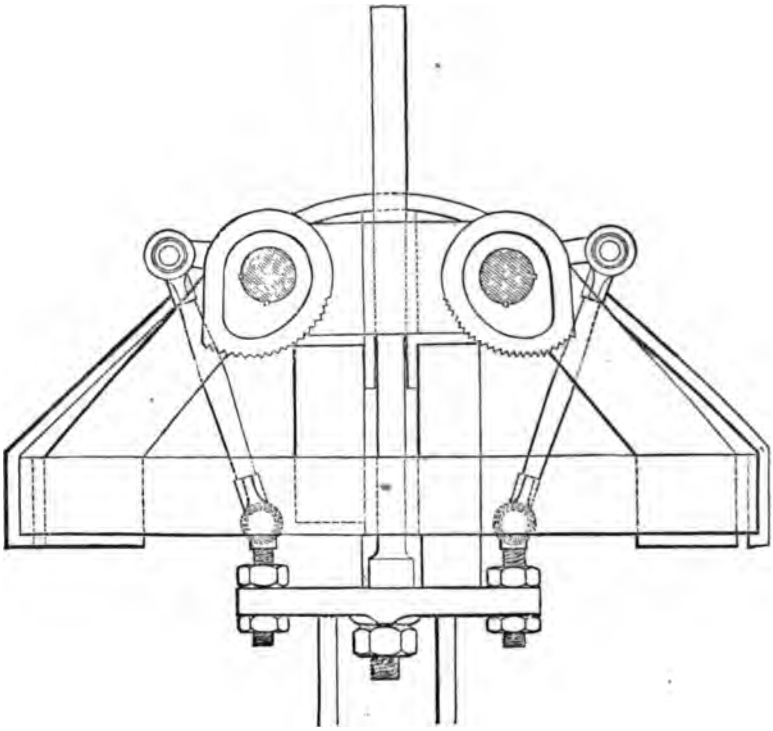


Fontaine's Parachute.

The Fontaine parachute has given satisfactory results in saving the lives of men, but the claws injure or destroy the guides. It also necessitates the use of very heavy timbers for the guides and their supports, inasmuch as pressure from the claws is exerted in one direction, and if the guides should yield or bend outward the effect would be lost. The first cost of such heavy guides and timbering is very great, and any accident, by destroying a portion of the guides, requires a great expenditure for repairs.

AUDEMAR'S PARACHUTE.

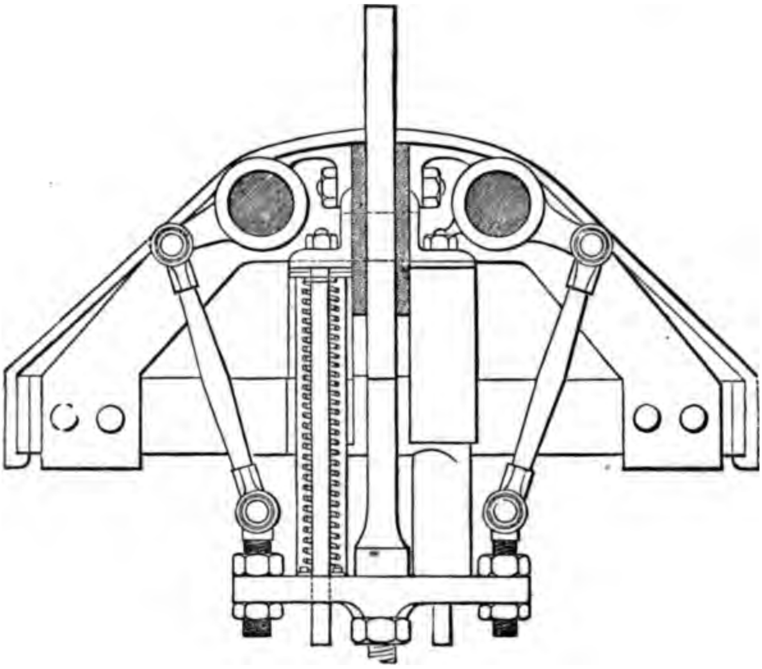
In order to avoid these difficulties other constructions have been devised. One by Mr. Audemar, engineer in the service of the mining company at Blanzy, is shown by the annexed figures. It consists of four eccentric wedges, two on each side, and placed on opposite sides of the guides; the release of the springs by the breaking of the cable causes these eccentrics to turn and to powerfully squeeze the guides and thus stop the descent of the cage. This parachute is as certain in its action as that of Fontaine, and does not split the guides. The guides and the framework may also be made much lighter, for there is no outward thrust or pressure tending to bend or break the timber.



Audemar's Parachute.

It will be noted that the action of the "dog-clamp" safety catch upon the cage used in Nevada (see p. 56) is similar to that of this eccentric catch. The *sides* not the face of the guide are acted on in both cases.

The spiral springs used by Mr. Audemar are made of steel wire $0^m.01$ in diameter. When fully expanded they are $0^m.39$ long, (nearly 10 inches,) and they may be condensed to a length of $0^m.25$; but in order to preserve their full elasticity the springs are condensed from $0^m.09$ to $0^m.11$ only. A compression of $0^m.09$ is sufficient, and this gives a resistance of 180 kilogrammes, (about 360 pounds.) Motion is communicated from the springs to the eccentrics by means of arms and levers, as shown in the figures. The first figure shows the position of these arms and the eccentrics when the cage is suspended by the cable; and the second their position when the strain from the cable is released and the springs are expanded. The spiral springs are contained in cylindrical boxes, one part sliding over the other. One of these boxes and the spring are shown in section in the second figure.

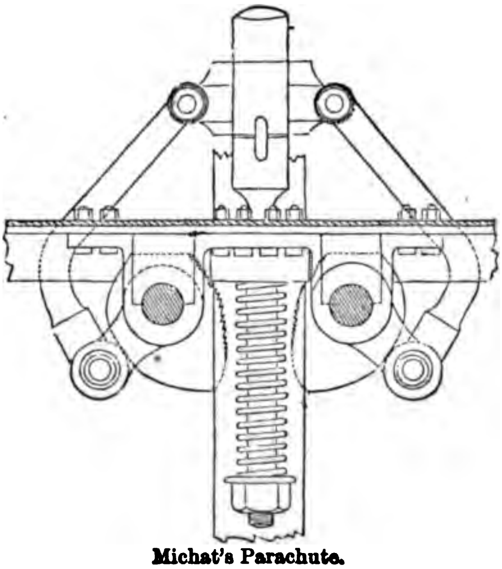


Audemar's Parachute—section showing one of the springs.

The experience of more than fourteen years with parachutes of this type has been most satisfactory. In this construction the springs are kept in constant use by being compressed and they thus relieve the shock when the cage is started.

MICHAT'S PARACHUTE.

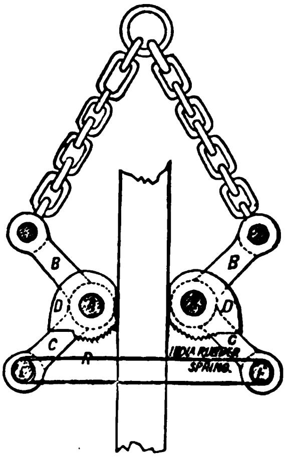
A variety of the same type as the Blanzy construction, designed by Mr. Michat, is shown with sufficient clearness by the appended figure, and a description is unnecessary. It is evident that it does not differ essentially from the parachute just described.



Michat's Parachute.

BRAUNE'S PARACHUTE.

This is a third variety of the same type, but it differs from the others by its extreme simplicity and the nature of the spring. This form originated with Mr. Braune, chief engineer of the mines of the



Braune's Parachute.

Vieille Montagne Company. A simple India-rubber band spring is all that is used to draw the eccentrics in upon the guides. It is said to have given satisfaction for a period of three years or more; but it is doubtful if a spring of this nature can long remain active and reliable when under constant tension.

PARACHUTE WITH WEDGES.

The third type of parachute is known as Nyst's, and is constructed to act like a wedge. It has arms like a parachute with claws, but the latter are replaced by a metallic jaw, in the form of a hollow wedge, fitting to the form of the guide, which is made wedge-shaped. When the parachute with the cage is sustained by the cable, the jaw moves along the guide without touching it; but if a rupture occurs, it then presses upon the guide and wedges powerfully, so as to arrest the descent of the cage within a distance of only $0^{m}.25$ or $0^{m}.30$. The action is thus very prompt, but it is so gradual that there is no perceptible shock.

This construction does not injure the guides, and it has the advantage over the parachutes of the second type that iron guides may be used, the reduced size of which is much less cumbersome in shafts than heavy timbers. It, however, requires the guides to be made with great accuracy, and uniform in size and angle of the wedge, and the difficulty of obtaining them has prevented this parachute from coming into general use.

THE VALUE OF SAFETY-CATCHES IN SAVING LIFE.

Although the construction of parachutes has not by any means reached perfection, there being some difficulties attending their use, they have rendered the greatest service in mining operations, repeatedly preventing great losses of life and property; and no excuse can be received for allowing a single mining cage to be without one wherever miners are permitted to ascend and descend in it. Accidents from the unaccountable breaking of the strongest cables are not infrequent; and when it is well known to mining engineers that parachutes of the proper construction have repeatedly been the means of saving life, it is strange that there should be any hesitation in adopting them. Even while writing this chapter the report of a recent accident (January, 1870) at one of the shafts of the Dowlais Company has been handed to me, and a condensed account of it is inserted as appropriate in this connection:

> A fatal accident happened at the Deep Pit, Vochrhiw, the property of the Dowlais Company, on Saturday afternoon, about 5 o'clock, by which five persons lost their lives. It appears five men were ascending the pit, and when within 27 yards of the top the rope broke and the poor fellows were precipitated to the bottom, a depth of 500 yards. The bodies were smashed to pieces, and death must have been instantaneous. This is the same pit where a similar accident occurred a month ago, when two men lost their lives. It happened in the same manner as the one on Saturday, and apparently from the same cause. The Vochrhiw pit is a very large colliery, employing about 600 hands. It is 400 yards deep, and is worked by two shafts, Nos. 1 and 2; the No. 2 being the shaft generally used for the passage up and down of men and horses, the other shaft being reserved for mineral alone. But, as these accidents show, the rule adopted by the company has not been kept by their men

The pits are worked by spiral drum—an invention which has called forth on several occasions the approval of the government inspector, as they enable the engines to raise heavy weights as well as the cage and rope of a pit 400 yards deep with ease, and without any extra power. But then safety depends chiefly, we may say, upon the angle formed between the rope and the pulley above the shaft with certain portions of the drum. It ought not to exceed ten or eleven degrees, though the angle at the time of the first accident was as much as fifteen degrees, and to that Mr. Wales ascribed the accident, as it produced the overlap of coil which led to the accident. On that occasion the coil overlapped when the men were two hundred and fifty yards from the bottom, and the jerk caused by its falling into its place snapped the rope and precipitated the cage to the bottom. On Saturday night the No. 2 pit was busy between 6 and 7 o'clock in bringing out the colliers, and there were then at the bottom of the No. 1 shaft four hitchers and the overman of the pit. In their anxiety to get out without walking through the workings to the other shaft, it is conjectured the whole of them got into the cage of No. 1 shaft, and signaled to the banksman to set the engine in motion. The engine started, and the cage was brought to within 27 yards of the bank when the fatal overlap of coil again occurred, and the jerk which followed snapped the rope and brought about the dreadful catastrophe.

Here we have the particulars of two fatal accidents from the same cause, and in the same mine, within about a month; and it does not appear that any effort was made after the first accident to prevent a second, nor does it appear that the cage in either case was provided with any form of safety-catch. At the inquest after the first accident at Dowlais, it was testified by the engineer's foreman that a similar accident, but to an empty cage, had previously occurred in the same pit.

In the Colliery Guardian of September 16, 1869, there is an account of a shocking accident which occurred at the Kirkless colliery, Wigan. The men were leaving the pit early in the afternoon, and while eight of the number were being drawn to the surface the wire rope on one side of the drum slipped as it was being wound on, the loose coils fell over the flange at the end, became entangled in the eccentrics at the side, and, weakened by the chaffing which it had received by being pressed between those revolving parts, parted by the sudden jerk given by the cage as it took out the slack in descending. The cage, containing eight persons, fell, of course, to the bottom of the shaft, a distance of 270 yards, and several men were instantly dashed to pieces. At the inquest upon the bodies, the government inspector said the drum was rather too conical, and, in his opinion, some slight deflection of the pulley had caused the rope to coil back, and so led to the slip. A drum of that shape required the nicest management and care in keeping the pulleys straight.

Here is another account, of an accident in Pennsylvania, reported in the daily papers since this chapter was written:

SHENANDOAH CITY, SCHUYLKILL COUNTY, *March* 29, 1870.

A terrible accident occurred at the coal mine of Richard Hecksher, a few miles from this place, at an early hour this morning. While four men were descending the shaft to commence the day's work, the rope broke, precipitating them to the bottom, over 60 feet. All were instantly killed.

There appears to be great opposition on the part of English miners to the introduction of any form of the parachute. In some observations by a "miner," upon the above-described accidents, the following passages occur:

Are any of the safety-cages, which have from time to time been invented, really suitable and efficient; and, if so, why are they not adopted? Now, the fact is, a really suitable and efficient safety-cage has still to be discovered; all that have yet been brought forward being objectionable for one reason or another. That many of the contrivances are highly ingenious cannot be questioned, but in practice they have, without exception, been found wanting; either they are too fragile, damage the guides, or require such continual attention to keep them in order that it is dangerous to place reliance upon them; and it is generally felt that if reliance be placed upon an apparatus of the failure of which there is a remote probability, it is better to depend upon the rope alone. The various safety-cages which have been proposed are readily refera-

> ble to two classes, and the great question is, which class is the best? One class of catch—for really the safety-cage is merely a safety-catch applied to an ordinary cage—is so arranged that it is brought into play at the end of each journey up and down the pit, the object being to prevent the apparatus becoming worthless from disuse. The idea is doubtless good, but the objection is, that the wear and tear are so great that the apparatus is worn out and useless before it is required to avert calamity, the consequence being that when the accident happens it is fatal, as usual. In the other class the apparatus is never brought into play until the accident occurs, the object being to avoid the dangers inseparable from the former; the wear and tear are, of course, prevented, but frequently, when the accident happens, it is found that the whole concern has become fixed from disuse.
>
> Perhaps the only arrangements not open to these objections are those somewhat like Aytoun's and Nyst's, each of which depends for its safety upon the mere change of position of a metal fork, or its equivalent, so as to become fixed against the guide-rods. Both of these catches are extremely simple, have no springs, or similar contrivances, to get out of order, and would not cost more than a few shillings to apply them. It has been said that they knock the guide-rods to pieces when they are brought into action, but as the damage can only occur when an accident has happened, and a calamity been averted, surely this should not prevent their adoption. As neither are protected by patent, every colliery proprietor can have them made by his own smith. It is a very common opinion among practical men that the use of safety apparatus begets carelessness on the part of those engaged about the shaft, but perhaps the ground for this complaint is more apparent than real, and as the cage is without question as safe with the apparatus as without it, it might be desirable to accept reliance on the catch as more than equal to the diminished attention of the men.

The last paragraph of this extract is a good answer to the general drift of the opinion expressed by the British jury upon the safety-cages exhibited in the International Exhibition of 1862: "The jury gave careful attention to all the varieties of this apparatus, and were strongly impressed with the merits of several of them, and with the desirableness of enlisting in this cause the interest of the intelligent mechanician. But they share in the repugnance of colliery viewers to trust to the action of a spring on which most of them depend, and which, of whatever substance it is made, is sure by degrees to lose its elasticity, and is thus liable, unless frequently looked after, to fail at the moment when required. They are also aware that a great inconvenience, not to say danger, has been introduced by all those hitherto employed, in consequence of the apparatus being brought into play by a plunge during the rapid descent of the cage, and that hence several of these inventions, after being fairly tried for one, two, or three years, have been ultimately removed. Nor is it too much to say, although an insufficient argument if taken alone, that the employment of this apparatus has a tendency to make people careless about the examination and renewal of ropes."*

In view of the very satisfactory experience with parachutes in the large collieries upon the continent, and, above all, the fact that they have repeatedly saved many lives, the writer trusts that their use will not be neglected in the mines of the West; and it is gratifying to know that they are now attached to most of the cages in the mines upon the Comstock lode.

It would not be difficult to collect many accounts of fatal accidents in those mines, which probably could have been avoided if properly constructed parachutes had been used. There is one remarkable case on record, showing the usefulness of another precaution, though it providentially failed to be another of the terrible warnings which call for the use of parachutes: A cage in the Hale and Norcross Mine was precipitated to the fifth level, a distance of 230 feet, without breaking any bones of a man who was upon it. The entire steel-wire cable fell down the shaft and coiled upon the roof of the cage. The roof protected the miner from being crushed by the cable; and this shows the importance of placing a hood upon every cage in which miners are conveyed. The form of such a hood is of some consequence. There is a case on record in England of a miner, standing in a drift near the bottom of a shaft, being killed by a pebble which, falling from the surface upon the dome-shaped roof of the cage, glanced off and struck him.

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* Reports of the British jury, Exhibition of 1862.

Examples are not wanting of the utility of safety attachments to cages in mines upon the Comstock lode. In February, 1869, a steel-wire cable was broken in the Imperial-Empire shaft; but, owing to the safety attachment to the cage, no other damage was done. The Mining and Scientific Press of San Francisco, in September, 1865, reports that in one of the mines (the Sierra Nevada, it was believed) a safety cage, heavily laden with ore, had nearly reached the top of the shaft when the rope parted. The safety catch prevented a free fall, but the load was so heavy that the descent of the cage was not completely checked, and it went to the bottom so slowly that not a bolt or timber was broken. Frequent experiments made in the Comstock mines, by cutting the cable above a loaded cage suspended in the shaft, have proved the efficiency of the parachute.

SAFETY HOOKS.

With the modern powerful and rapidly winding engines, the least inattention on the part of the engineer as the cage nears the surface may permit it to ascend to the sheaves and produce great destruction. Numerous and fatal accidents from this cause are reported in the mining journals. Even while this report is printing, accounts of an accident at a colliery near Wigan[*] show the fearful results of over-winding, and the importance of some means of prevention. Various contrivances have been proposed and adopted to prevent this over-winding. Safety-hooks, which open and leave the cage free to rest upon spring-catches below it, are the most common; but it would seem that the best contrivance of all is the very simple one of placing one arm of a lever, a bent bar of iron, in the path of the cage, so that if it passes that point the supply of steam to the engine is shut off, and the valve of the steam-brake is opened. Thus, by one blow upon this bent lever, the engine is stopped, the brakes are applied, and the winding of course ceases. This has been rendered possible by the addition of the powerful brakes operated by steam.

Among the many forms of detaching-hooks which have been proposed, there is one which is advertised in the English journals as extensively used in collieries. Its construction will be seen from the figure. It consists of two plates, placed face to face, and turning upon a central bolt. It forms a part (a link) of the winding cable or chain, and is so made that if drawn up through a hole in a cross-beam, bushed with a heavy cast iron lining, E, E, the expanded wedge-shaped sides, H, H, are pressed together, by contact with E, E, so as to liberate the bolts of the cable, A and B, at D and D. At the same time a square shoulder upon each plate of the link catches upon the upper edge of the hole, and sustains the weight of the cage. This is said to be extensively used. A form of safety-hook used in Nevada is shown upon a previous page, in the drawing of the cage now in use upon the Comstock lode.

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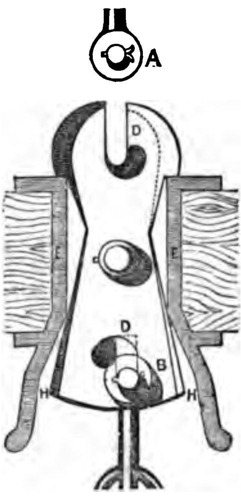
[*] *Extraordinary colliery accident near Wigan.*—Shortly before 10 o'clock on Tuesday night a shocking colliery accident, by which one man was killed and four others received injuries more or less serious, occurred at Messrs. Blundell's No. 1 Sinking Pit, situated in the township of Pemberton, near Wigan. The shaft has been in course of construction for nearly a couple of years; it is of more than the ordinary diameter, and the work has hitherto progressed without serious impediment. The men employed work in eight-hour "shifts," and at a quarter to 10 on Tuesday preparations were made for bringing one of these working parties to bank. Four men entered the hoppett to ascend, and they were drawn to the surface; but here the engineer, Thomas Ackers, found he was unable to reverse the engine or to apply the brake, owing to some derangement of the machinery. The consequence was that the hoppett was drawn at great speed over the pulley, and then through the roof of the engine-house into the building itself, which was a perfect wreck in a few seconds. Two of the men, fearing, from the speed at which they approached the surface, that they were about to be "pulleyed," made a desperate leap for life as they reached the bank, and one of them escaped, comparatively speaking, uninjured, while the other, fearfully shaken, was falling into the pit-shaft, when he was saved by the banksman. A third, named Butler, kept his place until the hoppett arrived at the engine-house, when he was flung a distance of forty yards over the building, and he, too, escaped with his life; but the fourth was not so fortunate, as he was dragged into the house and killed instantaneously. The engine tender was also seriously hurt by the falling débris.—*From the Colliery Guardian, March* 11, 1870.



Safety Detaching-hook.

The safety-hook by S. Bailey, proposed in 1860, consists of a fixed ring between the guides over the shaft, through which the cable passes. When the cage is drawn up too far this ring acts upon two projecting arms, which detach the cable, while, at same time, hooks are thrown outward over the ring, and by these the cage or kibble remains suspended.[*]

SIGNAL INDICATORS.

Carefully made indicators are now attached to winding engines, in such a manner that the position of the cage in the shaft is shown to the engineer by the movement of an index or pointer along a horizontal scale, and as the cage approaches the top a bell is sounded once or twice, and if it ascends too far the apparatus shuts off the steam and stops the engine.

CHAPTER LXXIV.

RAISING WATER.

It is unnecessary here to do more than mention the very common method of raising water from mines of small extent by means of the tub and windlass, precisely as ore is raised, or by a barrel fitted with a large valve in the bottom, which opens and allows the barrel to fill automatically when it reaches the sump. This method was in use at the Amador mine to a depth of at least eleven hundred feet, the buckets being of iron and cylindrical, like the tubs for ore, and sliding like them upon the guides along the inclined shaft. Guided skips fitted with valves are similarly used.

In Virginia City, Nevada, along the Comstock lode, many of the shafts were kept drained by these simple means, and the only apparatus worthy of further note was the method of delivery of the water into movable launders. When the barrel of water reached the surface, a launder, running upon rails laid on each side of the shaft, was pushed under it. The barrel was then allowed to descend and rest upon cross-bars, and, by raising the valve, the water was discharged into the head of

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[*] Jour. Mining, 1860, and Rev. Universelle, May and June, 1860, p. 511.

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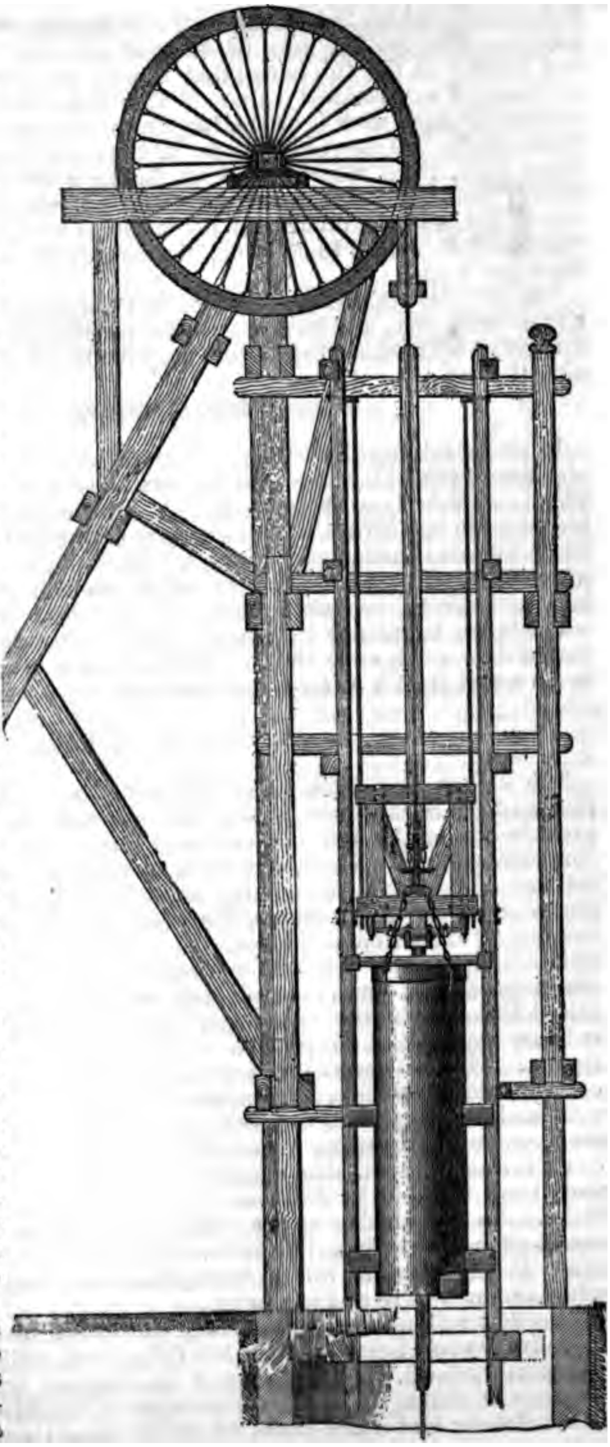

Apparatus for Hoisting Water.

frame-work, which throws open the discharge valve and lets the water escape. The motion may be stopped as soon as the valve is open, and as soon as the tub is emptied it may be lowered without any loss of time. The practical value of this improvement is shown by the results obtained with it at the Lucy pits, near Montceau-des-Mines. At these shafts, 200 metres in depth, 30 tubs of water, containing 25 hectolitres each, were raised per hour, being a total of 750 hectolitres of water; but this being insufficient, the automatic discharge apparatus was added, and the number of deliveries of tubs of water at the surface was easily increased to 50 or 60, discharging from 1,200 to 1,500 hectolitres per hour.

The lift and plunger pumps used in California and Nevada are generally of small size, and have no special peculiarities. They are generally connected with either the engine used for hoisting or with that for running the mill.

CHINESE PUMP.

In placer mining the "Chinese pump" is much used for draining the pits where the water does not require to be raised to a great distance. This is essentially a chain-pump. A continuous belt of canvas 5 or 6 inches wide has cleats of wood firmly secured to it at intervals, and is made to pass continuously through a rectangular box, the lower end of which is fitted with a roller over which the belt passes, and is inserted in the water to be raised from the pit. The upper end delivers the water into a launder or trough, by which it is conducted away. The belt passes over a wheel at the top, and motion is given either by the hand or by a belt from a water-wheel near by.

DRAINAGE BY SIPHONS.

The siphon has often been brought into use for draining in mines, pits, and quarries, where it was not necessary to raise the water to a great height, and where the necessary fall for the delivery end could be conveniently had. There has been a notable example of the successful use of a siphon on a large scale during the past year at a deep placer claim in Gravel Range, Tuolumne County, California, where Mr. George A. Treadwell employed one a little over 1,000 feet long and 4 inches in diameter. This pipe was made of No. 24 galvanized iron, in joints 30 inches long, riveted and soldered together. The water was raised 18 feet, and the discharge end had a fall of 40 feet, so that the delivery was 22 feet lower than the receiving end, or shorter leg of the siphon. The two ends of the pipe were furnished with large 4-inch brass cocks, which were closed when the siphon was to be filled. The filling was easily accomplished in about two hours by means of a 3-inch Douglas force-pump, throwing water in at the highest point through a vent cock, through which, also, smaller quantities of water could be supplied from time to time to displace air that gradually accumulated through leaks. An air-chamber at the bend was projected, but was not made, inasmuch as it was found to be but little trouble by shutting the 4-inch cocks at each end to fill up the siphon with the pump in a short time when the men were at their meals.

The flow at both ends was easily controlled by the cocks, the lower or delivery cock being usually left fully open, while the receiving cock was partly closed. The velocity of the current was sufficient to carry out tons of coarse sand and gravel, some of the latter as coarse as English walnuts; and sluice-boxes set at the usual slope were kept half full of water. There was no trouble in keeping the water within 2 inches of the receiving end, and this was plunged to within 5 inches of the bottom of the shaft.

PUMPING ENGINES IN THE EUROPEAN MINES.

There are three principal types of pumping engines for mines:

1. The single-acting balance-beam engine, known as the Cornish engine.
2. The single-acting engine, working the pump-rods direct, without a balance beam.
3. The double-acting engines placed in the interior of mines.

As explanatory of the construction and working of the first type, I nsert a very clear and interesting description of a Cornish engine of the largest class:*

CORNISH PUMPING ENGINE.

The engine called Taylor's engine was erected in the year 1840, at the United Mines in Gwennap, now included in the Clifford Amalganated Mines, and is worked with high-pressure steam, with expansion and condensation. It is single acting; that is, the steam is only employed for lifting the pump-rods and filling the pump-barrels in the shaft; the return stroke, which drives the water out of the pump barrels into the rising pipes being effected by the fall of the shaft rod, as soon as an equilibrium is established in the cylinder, by opening a communication between the two faces of the piston. The steam piston moves vertically in a cylinder formed of two concentric tubes, the inner one formng the cylinder, and the outer one a protecting case, or jacket; the small annular space between the two is constantly filled with steam at the maximum pressure produced in the boilers, in order to keep the walls of the inner cylinder at a uniform temperature. In practice, it is customary to surround the cylinder with other non-conducting envelopes; thus, a shell of brickwork inclosing an air space is first placed round the acket, which is further inclosed with coatings of felt, lagged with wood. These outer envelopes are not shown in the model. The piston-rod is attached by Watt's parallel motion to the end of a beam oscillating about a horizontal axis, whose bearings are carried on the outer wall of the engine-house. The beam is formed of two parallel cast-iron plates bolted together, the two plates being kept a fixed distance apart by wrought-iron pins. The two arms of the beam are of unequal length; the steam piston and mechanism for working the valves are attached to the longer arm, which works within the engine-house; the main pumprod and rods of the air and feed-pumps are attached to the shorter arm, which works in the open air; a gallery projecting from the wall of the engine-house gives access to the bearings on the out-door side of the beam.

The engine has four valves for the distribution of the steam; three of these are placed near the top of the cylinder, and the other one is at the bottom. One of them is a plain disk valve, with a single conical beating face, and is independent of the engine; the other three are of the kind known as the double beat, or Hornblower's valve, a construction in which the bearing faces opposed to the pressure of the steam are reduced to a pair of narrow conical rings, the valve and its seat being so formed as to present a very large steam passage when open. Of the three upper valves, that on the right-hand side (as seen when facing the cylinder from the outside) is the governor, or regulator valve. It is a plain disk valve, which is maintained at a fixed opening by means of the setting screws on the rod attached to the right-hand pillar of the valve gear framing. By this valve the steam is admitted from the main steam-pipe through the large hollow column on the right into the top steam-chest. The central valve is the admission valve; it commands the passage whereby the steam at full pressure enters and leaves the cylinder above the piston, and is governed by a system of levers attached to the uppermost of the three horizontal shafts, which are attached to the two vertical pillars or standards in front of the valve cases. The left-hand upper valve is the equilibrium valve; it is placed at the top of a hollow column, through which the steam passes from the upper to the lower face of the piston, in order to establish an equality of pressure at the end of the steam-stroke; the movement of this valve is effected by the central arbor. The bottom, or exhaust, valve, which controls the passage of the exhaust steam from the cylinder to the condenser, is attached to the lower horizontal arbor.

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* This description is extracted from Bauerman's Descriptive Catalogue of the Mining Models, &c., in the Museum of Practical Geology, attached to the London School of Mines.

The valves are opened by falling weights, and closed by the action of tappets on the plug-rod, acting on curved handles projecting from the front of the horizontal shafts. The sector-shaped cams and catch levers outside the bearings of the horizontal arbors keep the valves locked in position during the repose of the engine.

The engine is intermittent in its action, a pause being made after the descent of the main rod in the shaft, varying in duration according to the amount of water to be lifted; this is effected by a simple hydraulic regulator, known as the cataract. The cataract, which is placed in the well below the floor of the engine-house, is a square wooden plunger box. open above and closed at the bottom, with the exception of a small conical hole, which can be stopped by a plug attached to a vertical rod: the plunger moves in a square cistern of water, a little larger than itself, and is attached to a vertical rod passing through a collar projecting from the right-hand frame pillar; it is further attached by a chain rolling on a sector-head to a double-armed lever, which oscillates about a horizontal axis; the shorter arm of this lever is pressed down by a roller at the lower end of the plug-rod, during the upstroke of the engine, a balance weight being fixed to the end of the opposite arm, which raises the shorter arm when the pressure of the rod is taken off. The action of the cataract is as follows: When the in-door side of the beam makes its down stroke, during the lifting of the main rod in the shaft, the cataract plunger is driven down in its cistern, displacing the water in bottom of the latter, which consequently rises above the open top of the plunger box and fills it up; this water afterward flows out through the small hole in the bottom of the box with more or less rapidity, according to the position of the conical plug; and during this time the valves are closed and locked by their catches, the steam piston is at the top of its stroke with a slightly compressed cushion of steam above it, and the expanded steam of the preceding stroke below it. As soon as sufficient water has flowed out of the cataract plunger to establish the preponderance of the balance weight on the longer horizontal arm of the lever, the box rises, and the rod attached to it opens the exhaust valve by striking against the catch lever and releasing the balance weight. The steam below the piston flows away to the condenser, and a vacuum is formed in the cylinder. The catch on the steam valve is formed by the vertical arm of an angle lever, whose horizontal arm is parallel to the exhaust-valve catch, and is connected to it by a parallel bar with a slotted link at the top, which works on a pin at the end of the horizontal arm of the upper catch.

When the bottom of the link strikes the pin, the steam valve is opened in a similar manner to that already described for the exhaust valve. The piston descends under the full pressure of the steam in the cylinder until the link frame at the back of the plug-rod closes the valve, by pressing against the handle which projects from the top arbor, the sector on the arbor, in turning, gradually lifting the catch lever, which falls into its place as soon as the end of the cam has passed the notch. The steam is now cut off, and the remainder of the stroke is effected by the expansion of the steam already in the cylinder. The length of the full steam stroke is determined by the position of the link frame on the plug-rod; the proportion of expansion is diminished or increased by raising or lowering the link by the setting screw on the front of the rod.

The exhaust valve is closed by the plug on the right-hand side of the rod shortly after the closing of the steam valve. The equilibrium valve is opened at the end of the stroke by its balance weight; this establishes a communication between the upper and lower faces of the piston, equalizing the pressure on both sides, when the piston is drawn up in the cylinder by the excess weight on the outer side of the beam. The equilibrium valve is closed by the left-hand plug during the rise of the rod. This confines a small quantity of steam above the piston, which forms a cushion by compression, and brings the moving mass to a state of rest.

The condenser and air pump are connected with the out-door side of the beam. The latter is surmounted by an open hot well of large capacity. The feed pump draws its supply directly from the hot well, and forces the water through a double U tube, passing four times through the exhaust pipe, where it is heated by the waste steam on its passage from the cylinder to the condenser. The feed water is further heated by circulation through a system of horizontal pipes in a flue at the back of the boilers. The steam from the six boilers is collected in a cylindrical steam chest, with hemispherical ends, cast in two pieces, which are united by a wrought-iron expansion joint. The main steam-pipe passes from the chest under the floor of the engine-house, and terminates in the right-hand vertical column, at the top of which the governor valve is placed. The main rod which works the pumps in the shaft is formed of two square balks of timber placed side by side, and united by wrought-iron fish plates and bolts. The excess weight of the rod above that necessary to drive the water out of the pump barrels is balanced off by five balance bobs, of which three are placed under ground and two are at the surface. The latter are cast-iron beams, constructed in a similar manner to the beam of the engine, one end being connected by a wooden rod with the main rod on the shaft; the other carries a wooden box, which is loaded with masses of rock, acting as a counterbalance. Catch pieces, or stops, are fixed to either side of the beam to prevent it going beyond its proper distance in case of breakage on either side. The in-door catch is formed by an iron cross-piece fixed above the beam which is received on a pair of spring beams carried on horizontal balks crossing the upper part of the engine-house. The out-door catch is formed by two pieces of timber strapped on to the front of the main rod. The lower ends of these beams, which are of the same size as the main rod, are caught by a mass of timber formed of horizontal balks piled one above another in the shaft. This bed of timber is not shown in the model.

The large capstan and shear frame over the shaft lead the rope by which the pump barrels, &c., are lowered in the shaft. It is worked by manual power.

The following are the dimensions of the more important parts of the engine:

Diameter of steam cylinder		85	inches.
Length of stroke of piston		132	inches.
Diameter of regulator valve		10.8	inches.
Diameter of admission valve		15.0	inches.
Diameter of equilibrium valve		18.5	inches.
Diameter of exhaust valve		25.0	inches.
Diameter of main steam pipe		18.0	inches.
Diameter of exhaust pipe		24.0	inches.
Diameter of condenser		30.0	inches.
Diameter of air-pump piston		37.0	inches.
Diameter of air-pump valve		30.0	inches.
Diameter of hot well		55.5	inches.
Diameter of feed pump		6.0	inches.
Length of main beam	34 feet	2½	inches.
Height of main beam at centre	7 feet	1½	inches.
Length of beam, steam side	17 feet	10½	inches.
Length of beam, out-door side	16 feet	4	inches.
Length from centre of beam to point of attachment of air-pump rod	9 feet	7½	inches.
Length of feed-pump rod	6 feet	8	inches.
Length of stroke of main rod	10 feet.		
Section stroke of main rod { breadth		24	inches.
Section stroke of main rod { depth		12	inches.
Diameter of piston rod		7½	inches.
Diameter air-pump rod		3½	inches.
Diameter of feed-pump rod		2½	inches.
Diameter of axis of main beam		20	inches.
Diameter of journals		16	inches.

Boilers:

4 of 30 feet length, 5 feet diameter of outer shell.
3 feet 4 inches diameter of inner tube.
2 of 34 feet length, 5 feet 10 inches external diameter.
Steam chest, 30 inches diameter.
Feed-pipe, 5½ inches diameter.

The engine was started in December, 1840; its performance was continuously reported in "Lean's Engine Reporter" up to the end of 1851. The most economical condition of working was reported in September, 1842. The mine was then 201.2 fathoms deep; the load on the piston amounted to 75,362 pounds, or 12.05 pounds per square inch of surface. The engine, making five strokes per minute, developed a quantity of work equal to 114.2 horse-power. The quantity of fuel consumed showed an effect of 107,494,580 foot pounds per bushel of coal of 94 pounds, equal to 1.74 pounds per horse-power per hour.

The last return, in December, 1851, shows a duty of 62,000,000 of foot pounds per bushel, or 2.9 pounds per horse-power per hour. The depth had increased to 239 fathoms; the load per square inch to 15.8 pounds, giving a duty of 165 horse-power, at a speed of 5.5 strokes per minute. The greatest working speed attained appears to have been in December, 1849, when the engine made 7.5 strokes per minute, showing

221 horse-power, with a consumption of 2.4 pounds per horse-power per hour. The method by which the above duties is computed consists in comparing the amount of coal burned with the theoretical volume of water discharged by the pumps during the period of observation. The actual volume is, however, somewhat smaller, the discharge of the best mining pumps being from 2¼ to 2½ per cent. less than the theoretical amount for each lift.

DIRECT-ACTING PUMPING ENGINES.

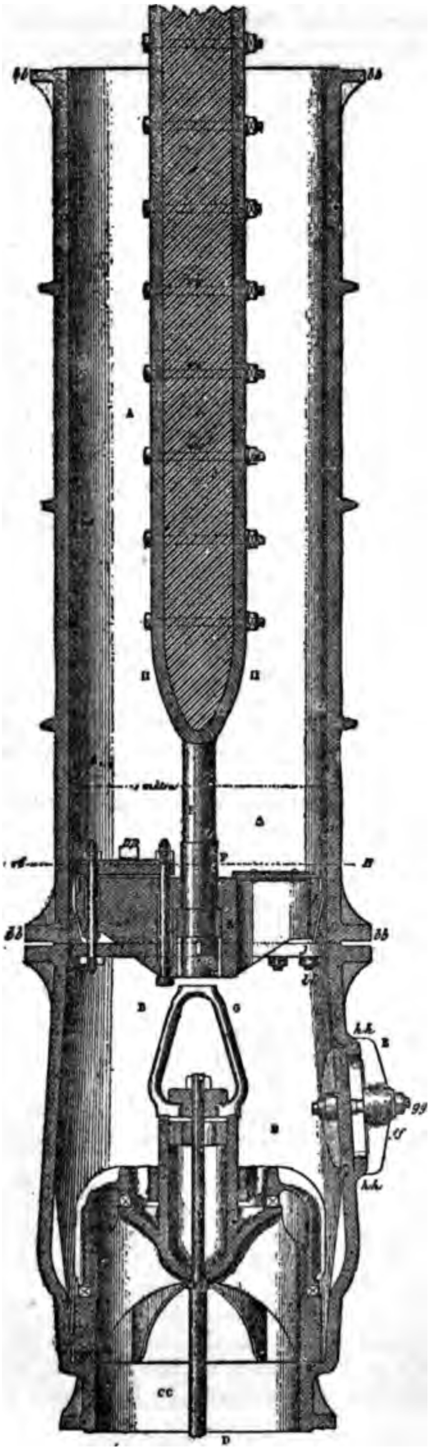
The models earliest imported from England, or constructed in France or Belgium, were all of the first type; but they were gradually replaced by those of the second, or the direct-acting engines, so that the use of the beam engine became exceptional. The two types, though so different in form, do not differ much in the details of construction. They are both single-acting and are provided with the same kind of apparatus for the distribution of the steam; and the Hornblower valves, used in both, are controlled by one or two cataracts.

In some cases, where there is very little space in which to place an engine, they are made without the condenser, and the cylinder is placed over the shaft, the piston-rod being connected directly with the pump-rod. This is the simplest and least costly form of pumping engine to erect, but the expenses of working with it are of course much greater than with condensing engines. Instead of the consumption of one and a half kilogramme of coal per horse-power per hour, as in the Cornish engine, the high-pressure engines consume four to five kilogrammes. For this reason condensing engines of the Cornish type are generally used, and of these the direct acting form has been generally preferred, but with the addition of the beam, for the purpose of counterbalancing the rods and for working the condenser.

Burat, in his *Matériel des Houillères*, sums up the relative advantages of the two types of construction, the balance-beam engines and the direct-acting engines, substantially as follows: The balance-beam engines are especially adapted to pumping where great diameters of cylinder are required, because they do not obstruct the mouth of the shaft; because their foundations, being at some distance beyond the sides of the shaft, are much firmer and more secure; and because the different parts of the apparatus are more accessible for cleansing and repairing.

The direct-acting machines are the best, when the cylinders do not exceed 1^{m}. 50 in diameter and the pumps, 0^{m}. 45. Their installation is more simple; they occupy less space, and can, in most cases, be placed over one compartment of a shaft used for hoisting, and without a special building; and the conditions throughout are much more simple than can be secured with the other type.

A failure to obtain as great an economy of steam in many of the French and Belgian engines as is claimed for the Cornish engines has led their engineers to think that the statements of the performance of the latter are exaggerated. In reality the average consumption in Cornwall is 1^{kil}.50 of good coal per hour per horse-power. It is but rarely that the consumption has been reduced to one kilogramme, when every part of the apparatus is in the most favorable conditon, depending upon the depth and diameter of the column, the size of the rods, and the proper relation of the force to the work to be done.



Bleiberg Lifting Pump.

BLEIBERG LIFTING PUMP.

The annexed figure reduced by the photo-relief process from Plate LXII of the Atlas of Burat's Matériel des Houillères, gives a sectional view of the pump barrel and the two vales of a lifting pump at Bleiberg. It is one metre in diameter, and is made for a height of column of 22 metres. The piston can carry a charge of 17,000 kilogrammes. The valve chamber B B is provided with a manhole E, securely closed by a cast plate held in position by a bolt and nut *gg*, passing through the cross-bar *ff*. The barrel of the pump is lined with bronze. It is 3^m.45 high, and the piston has a stroke of 2^m.85. The piston is pierced with eight triangular openings. The packing consists of a circle leather firmly secured to the piston by a ring of iron *j*. The lower valve is one of Hornblower's construction.

EXPERIMENTS AT BLEIBERG.

In the year 1850 a commission was formed to investigate the performance of the pumping machinery at the mines of lead and zinc at Bleiberg in Belgium. Engines of great power had just been erected, and the engineers of the establishments of Seriang had exerted themselves to produce the most perfect specimens, with all the latest improvements of the best Cornish engines.

The steam-cylinder of the engine at Bleiberg was 2^m.67 in diameter; (surface, 5^{m2}.5990;) the mean stroke ^{m}3.65; the relation of the arms of the beam 6.4:5; the stroke of the pump-rods 2^m.85. The steam being at a pressure of 2.90 atmospheres in the boilers, the initial pressure in the cylinders was 2.42 atmospheres. The steam was cut off at 0^m.70 of the stroke, and the remainder of the movement was performed by the expansion and the condenser, so that at the end of the stroke the steam occupied a space equal to five times its primitive volume.

The commission continued the observations from the 9th to the 15th of January, and reported them in detail.* The engine having worked during 127 hours 15 minutes, gave 50,043 pulsations, and 43,118 kilogrammes of coal were consumed. This coal was the stone-coal of Seriang, broken to the size used in Cornwall. The stroke of the pumps was maintained uniformly at 2^{m}.85, and the effective height of the column of water at 71^{m}.50. The result of these figures was that the machine gave a mean useful effect of 234 horse-power, and the consumption of coal per horse-power per hour was an average of 1^{kil}.448. Burat finds the relation of the force exerted to the effect produced to be as 377:234=1:0.621; and observes that this remarkable economy of fuel in a work which is far from being advantageous to the motor, since at each stroke it must overcome the inertia of an enormous mass, results from a series of favorable conditions in which the machines are established and work. These favorable conditions may be summed up as follows: 1. Generation of steam in boilers with large heating surfaces; good coal and good raking. 2. A steam chest of great capacity, and pipes and openings of large diameter for the admission and emission of steam. 3. Condensation as perfect as possible. 4. Expansion developed as much as possible, favored by the conditions of single action and the inequality of speed of the piston, which are coincident with the best conditions of movement for a column of water.

PUMPING ENGINE AT GRAND HORNU.

The great pumping engine of Grand Hornu was constructed at the works of Seriang, for a shaft 460 metres deep. It works a series of ight plunger-pumps and two lifting-pumps of 0^{m}.50 in diameter, and our metres stroke. These pumps are placed one above the other, at istances varying from 30 to 60 metres. The upper plunger-pump, 60 metres from the surface, is worked by a double rod, each arm having a quare section of 0^{m}.484 × 0^{m}.242, and being formed by the juxtaposiion of two pieces of 0 ^{2}.242. These rods are completely enveloped in ron 0^{m}.024 thick. The double rods gradually diminish in size toward he bottom of the shaft, but in each section the weight exceeds that of he column of water to be thrown out. The total weight to be counteroised is 200,000 kilogrammes; and this is effected by two balance eams mounted upon opposite sides of the master-rod, directly below he engine.

The engine is direct-acting, the cylinder being mounted directly over he shaft. It has three floors or stages: 1. The cylinder; 2. The conensers, with their air-pumps; 3. The balance beams. The cylinder is acketed to prevent condensation. It is 0^{m}.05 thick and is made in two ieces, each 1^{m}.60 high. There are three valves: the admission valve, ^{m}.42 in diameter and rising 0^{m}.06; the equilibrium valve, 0^{m}.51 in dimeter and rising 0^{m}.08; the exhaustion valve, 0^{m}.60 in diameter and ising 0^{m}.85. The condensers have a diameter of 1^{m}.20, and are 2^{m}.50 igh. The air-pumps are 0^{m}.95 in diameter, and have a stroke of 2^{m}.10. The balance beams are 11^{m}.40 long, and each carries 90,000 kilorammes of counter-weights, formed of plates of cast iron.

QUILLACQ'S PUMPING ENGINE.

At the Paris Exposition of 1867, M. Quillacq, who has already been mentioned as the constructing engineer of hoisting machines, exhibited he drawings of a very perfect specimen of pumping engine recently erected by him at the mines of Fiennes, in the Boulonnais, France. This was a single, direct-action engine, without the beam, as in the Cornish type. The cylinder is provided with a jacket of cast iron, inclosing a space in which steam circulates. The distribution is made by three valves of admission, equilibrium, and exhaustion, controlled by a double-acting cataract, which determines the time of rest at each extremity of the stroke. The cylinder, 2^{m}.65 in diameter, is 4^{m} long, and supported by two wrought-iron girders 1^{m}.35 high, placed in the walls of the building. The steam is admitted in the cylinder under a pressure of 3.75 atmospheres, and is cut off at half-stroke.

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* Proces-Verbaux de la Commission contradictoire.

The condenser has two air-pumps of 0^{m}.90 diameter, and 2^{m} stroke. The water is injected through two valves, one of which opens at the same time with the introduction of the steam, and the other at the same time with the escape-valve, so that at the beginning of the stroke the two valves are open, while at the end one of them is closed.

This machine is designed to raise water from a depth of 400 metres, by means of six plunger-pumps, and a lift-pump at the bottom. The diameter of the pumps is 0^{m}.60 and the stroke 4^{m}.00. The principal rod which transmits the movement to the pumps is of iron and weighs 200,000 kilogrammes. The following are the weights of some of the principal parts of the engine in kilogrammes:

Steam-cylinder	40,000
Iron girders	12,000
Piston-rod	4,000
Cross-head	1,600
Two equilibrium balances	40,000

The total weight of the engine and fixtures, without the counterpoise, is 175,000 kilogrammes.

The other elements are—

Six plunger-pumps	70,000
One lift-pump	7,500
Main rod	200,000
Counterpoise attached to the rod	75,000
Counterpoise attached to counterbalances	140,000

The total weight of the masses put in motion, including the piston and the beams, is 465,000 kilogrammes.

DOUBLE-ACTING PUMPING ENGINES—STEAM PUMPS.

The double-acting pumping engines placed in the interior of mines have been applied at depths of 100 to 150 metres, and for quantities of water reaching 10,000 hectolitres a day. The Blanzy coal companies have applied this system in their mines. They have erected a 300 horse-power engine at a depth of 340 metres, to throw 25,000 hectolitres of water to the surface daily. The drawings of this engine were exhibited at Paris, in 1867. The apparatus consists of two horizontal steam-cylinders, working four horizontal plunger-pumps, which force the water into an air-chamber with which the delivery column, 300 metres high, is connected. The apparatus is placed 40 metres above the bottom of the mine, and the water is lifted to that point by four lift-pumps, so that in case of accident or stoppage the pumps will not be covered with water.

There are many different forms of the double-acting steam pumps in the United States, and some of them have been successfully used in mines upon the Pacific slope. It is not possible here to describe all of the varieties offered to the public, and to discuss their relative merits. To single out one or two for description would not be just to the many inventors who have carried these pumps to great perfection.

PUMPING AT THE SAXON COLLIERIES.

The following is cited from the notes of Mr. W. Fairley, as an example of pumping at the Saxon collieries:

> The Pumping Engine Company at Zwickau, which drains the water from the Bockwa Manor, is worthy of notice. This manor is about 180 acker, or about 190 English acres area, and the company pumps the water for the different coal companies for the payment of a tax of 2½ groschen per 10 centner, or 6d. per ton English, of coal worked. The water does not exceed altogether more than 200 cubic feet per minute, and for lifting this they have two engines, one 84 inches (Saxon) diameter, 11 feet in the cylinder, and 9 feet stroke in the pump, working seven strokes per minute as the maximum. The pumps are two 23 inches diameter, forcing 250 feet long each, and one 23 inches diameter, lifting 100 feet long; the other engine is direct-acting, 68 inches (Saxon) diameter, with 10-feet stroke, working a 17½-inch set. For supplying these engines with steam, there are seven egg-ended boilers, each 7 feet diameter and 40 feet long.

WATER-PRESSURE ENGINES FOR MINES.

In mountainous regions, where water under a considerable head or pressure can be had, it may be advantageously utilized for pumping, hoisting, or other mining operations requiring power, by means of hydraulic engines and surface or underground wheels. There are many places on the Pacific coast where such engines can be introduced with advantage. They are usually constructed for pumping only, and are single-acting, with long cylinders placed vertically over the pump shaft, the pump-rod being simply a prolongation of the piston-rod. The water is admitted to the under side of the piston, and when it has run its upward stroke the water is allowed to flow out and the piston descends.

The absence of any sensible elasticity in water renders the motions resulting from its use under pressure in engines susceptible of perfect control; but the same inelasticity causes sudden shocks and blows to the moving parts if the inlets and outlets are made as in engines operated by the elastic fluids, steam or air. It is therefore necessary to use valves of peculiar construction, by which the flow of the water may be gradually increased or slackened, and to provide other means for preventing impact and securing smoothness of action.

Many such engines have been constructed for pumping mines abroad, and have operated successfully for long periods with very little expense or attention. One was erected by the engineer Trevithick at the Alport mines, in the year 1803, and worked continuously for forty-seven years, until 1850, when work upon the mines ceased. In this engine the water was admitted first upon one face of the piston and then upon the other, alternately, and the inlets and outlets were opened and closed by two pistons at the side.

An engine erected by Mr. Darlington at these mines had a cylinder 50 inches in diameter and a stroke of 10 feet. The cylinder was placed directly over the shaft and the piston and pump-rod were continuous. The column of water was 132 feet high and gave a pressure upon the piston of about 58 pounds to the square inch, or more than fifty tons upon its area. Water was raised from a depth of 22 fathoms by means of a plunger 42 inches in diameter, and when the mine was very wet, nearly 5,000 gallons of water per minute were discharged into the adit. The water under pressure was admitted under the piston only; cylindrical valves admitted a full flow for seven-eighths of the stroke only, and then commenced closing, while a small valve opened and allowed enough water to pass in to complete the stroke.

The largest engine erected by Mr. Darlington was similar in its general construction to that just described. It had a cylinder 35 inches in diameter; stroke 10 feet; pressure column 227 feet high. Its average speed was 80 feet per minute, and its greatest speed 140 feet per minute. The pressure of the water was 98 pounds per square inch, giving a total weight of 40 tons upon the piston. This engine was automatic, the motion was certain and regular, and the cost of maintenance was trifling.

Sir William Armstrong has made use of water pressure obtained from natural falls to produce rotary motion by means of a pair of cylinders and pistons, with slide valves, in some degree resembling those of high-pressure steam-engines, but provided also with relief valves. Water-pressure engines of this description were erected at the lead mines at Allenheads, in Northumberland, and are used for the various operations of crushing the ores, hoisting, pumping, and driving the machinery of the concentrating works. Small streams of water which flowed down the slopes of adjoining hills were conducted into reservoirs at elevations of about 200 feet, and from thence by pipes to the engines.

In a mining district upon the river Allen, in England, where the fall of the water is not sufficient to work water-pressure engines, overshot wheels have been used to force water into accumulators, from which it could be conveyed in pipes to the required points.

Table showing the locality, engineers, and dimensions of some of the principal water-pressure engines.

[From Ure's Dictionary, edited by Robert Hunt.]

Locality.	Engineer.	Diam'r of cylinder.	Length of stroke.	Speed per minute.
		In's.	*Feet.*	*Rev's.*
Northumberland	Westgarth	10		
Ems	Unknown	13½	4	[illegible]
Bleiberg	Unknown	7	6½	10
Chemnitz	Unknown	11	8	4
Ebensee, Salzsburg	Unknown	9½	1 5-12	17
Clausthal	Unknown	16½	6	4
Alte Mordgrube, Saxony	Unknown	18	8	64
Alport mines, Derbyshire	Trevithick	25*	10	120
Do	Fairbairn	36	5	70
Do	Darlington	50	10	140
Do	do	18	7	154
Do	do	24†	10	120
Do	do	24†	10	120
Lisburn	do	20†	6	96
Cwmystwyth	do	24†	10	140
Talargoch	do	50	10	140
Minera	do	35	10	140
Wildberg	do	3	5	40
South Helton colliery	Armstrong	3‡	12	200
Allenheads	do	6	18	120

* Double. † Two cylinders. ‡ Four cylinders.

Underground water-wheels are used in various parts of Germany, when the circumstances permit. Where a system of mines is drained through a deep adit, the water can be transferred from one mine to another, and its fall utilized by such wheels, until it finally reaches the level of the adit by which it escapes. Instances of this may be observed in the district of Freiberg, Saxony.

WATER-WORKS AT WHITE PINE

There is a very interesting exhibition of hydraulic engineering at the White Pine mines, due to the skill and enterprise of the distinguished engineer A. Von Schmidt. Water is there pumped a height of 900 feet in round numbers, in two lifts of 450 feet each. There are four large steam engines, two at each station, and each engine of 177 horse-power. The cylinders are 22 inches in diameter and they have a stroke of five feet. They can be worked together or independently. The water is forced through 12-inch pipes of boiler iron, and the capacity of the works is reported as 2,500,000 gallons daily.

CHAPTER LXXV.

RAISING AND LOWERING MINERS.

The ascent and descent of miners in the mines of the West, when of depths not exceeding 200 feet, is usually by ladders in one compartment of the hoisting shaft; but in all guided shafts where cages are used it is customary to descend and ascend in these cages. This is not only dangerous, but it interferes with the work of hoisting ore; and in all deep mines, especially in vertical shafts, it becomes important to provide some other safe and rapid means of hoisting and lowering the men.

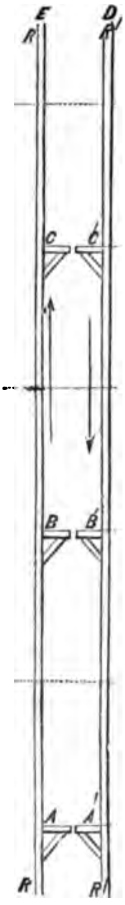
This necessity has been met abroad, and in some of our mines upon Lake Superior, by the introduction of the man-engine, known in Germany as the *Fahrkunst* and in France as *echelles mobiles.* They are all alike in principle, and consist essentially of two strong beams or rods hung side by side in the shaft of a mine. Each beam has platforms or landings large enough for a man to stand upon placed at equal distances from the top to the bottom. Handles to be grasped by the hands of the men are attached at a convenient height above each platform.

They are not a modern invention, having been known in Germany during the last century; but they did not become generally used, and were almost forgotten, until about forty years ago. Since then they have been used extensively in Germany, Belgium, and Cornwall.

In the year 1833, when the deep George adit was opened in the mines of the Harz, two water-wheels were thrown out of work, and the idea was suggested of using the pump-rods attached to them for the ascent and descent of the miners. The experiment was tried. The rods were strengthened, stages or platforms were attached at suitable distances, and a regular alternate up-and-down motion was given to them by means of the wheels. It was a great success; the miners were relieved from most of the arduous labor of climbing, and even invalids, who before could not reach the lower parts of the mine, were enabled to resume their work.

The principle of the man-engine will be made more clear by reference to the annexed diagram. R R and R′ R′ represent portions of two heavy rods or beams, extending from the top to the bottom of a shaft, and suitably guided and supported throughout their length. To these rods, and at equal distances, small stages or platforms, A B C, and A′ B′ C′, are securely fixed.

An alternate upward and downward movement is given to each of these rods; while the rod R, with its stages, is ascending, the opposite rod R′ is descending. This movement brings the platform A on the rod



R opposite to the platform B′ on rod R′, and the platform B opposite the platform C′. The motion is then arrested for a moment, and is immediately afterward reversed, and the platforms return to their original position. If miners are standing upon the platforms of R, they will all be raised by the upward movement a distance equal to half the distance between the platforms. At this point, the motion ceasing, the miners step from the platforms of the rod R to those upon the rod R′, and by the next movement are again lifted, when they step across as before, and so on until the top of the shaft is reached. The descent is similarly accomplished.

In some mines only one of the rods moves, and the other remains stationary, or rather the second rod is omitted, and stages are fixed to the side of the shaft in the rock itself; in such cases the single rod has to move the whole distance between two stages instead of half that distance, as when two rods are used.

When a single rod is used in connection with fixed stages, the miners pass alternately from the stage on the rod to the stage fixed in the rock. They then wait until the half-stroke brings a fresh stage opposite to them, on which they place themselves, and so on.

The distance between two stages on the same rod generally varies from $4^{m}.50$ to $8^{m}.00$. The stroke of the apparatus with two movable rods is always half the distance between the stages, consequently it varies from $2^{m}.25$ to $4^{m}.00$. There are from four to eight double strokes per minute.

The single-rod man-engine is the one most used in Cornwall. It makes three strokes of 12 feet each per minute. The rods are generally about seven or eight inches square, decreasing in size toward the bottom. The weight is counterbalanced by levers or by balance-bobs, attached at different levels.

Motion is imparted to the rods of the man-engine by means of water-wheels with cranks, steam-engines with crank-motion, or direct-acting steam-engines, the two rods being connected by balance-beams in such a way that their motion, though inverse, is equal and simultaneous. M. Warocqué substituted for the cumbrous balance-beams a column of water, contained between the pistons of two cylinders side by side, and connecting freely below the pistons, and made other improvements so important that the *echelles mobiles* are described in some publications as *Warocquères*.

The crank motion is particularly well suited to the movement of the man-engine, inasmuch as the velocity of the movement decreases gradually at the beginning and end, and becomes almost nothing as the crank passes the centre, thus giving time for the miner to step from one beam to the other, or from the beam to the stage fixed to the side of the shaft.

When direct-acting engines are used, there is a stoppage after each stroke to give the miners time to pass from one stand to the other. This stop varies from two to eight seconds, which is ample, as the passage from one stand to the other does not take more than one second. This would be a very good system if the stop were always rigorously the same. But all who have worked the machine with direct single action and cataract know that it is impossible to obtain this regularity. The irregularity may indeed cause accidents. The miner, relying on the normal time of the stoppage, may be surprised in the midst of the movement he is making, and as the single-action engine starts suddenly, and very quickly acquires a great velocity, he may have one leg roughly taken up while the other remains on the stage which rapidly goes down.

When the man-engines receive their reciprocal motion from a crank on a revolving shaft, there is, so to speak, no stoppage. The stages which approach each other are hardly on the same level when they separate again; but by taking care to have the machines provided with regulators and heavy fly-wheels, the movement is regular, and there is no change to surprise the miner at the moment of his passage from one stage to the other.

It must not be forgotten that the movement of the machine being uniform, that of the connecting-rod which commands the man-engine is variable. It is very slow at the commencement of its stroke, is accelerated at the middle of the stroke, and becomes slow at the end. The miner, thanks to the regularity of the movement and the slowness of speed, when the stages approach the same level and separate from each other, can begin his passage from one rod to the other a little before the stroke, and continue it a little after.

Experience proves that this second method is the safest. The persons who go down for the first time on these machines do not experience any disagreeable sensation. It is not so with the single-acting machines; when, after the stoppage, the stage lifts or lowers a person suddenly who is not accustomed to them, he experiences a disagreeable sensation, (a sinking at the stomach,) which is increased by the sudden stop at the end of the stroke. This feeling is similar to that experienced when one is lowered or "dropped" suddenly in a cage; and, with some persons, produces sickness and fainting. In the Saxon mines, at Freiberg, the movement is given by water-wheels and cranks; and there is nothing about it unpleasant or awkward to any one accustomed to life underground. The writer, after watching the movement of the rods for a few moments in one of the shafts, stepped upon and used them without difficulty. There is always this advantage to one unaccustomed to them, that if, from any cause, the step from one stage to the other is not taken in time, it is perfectly safe to remain upon the rod and be lowered and hoisted again.

Man-engines worked by direct-acting engines, in order to raise the same number of men in a given time, must move more rapidly than when the motion is communicated by a crank.

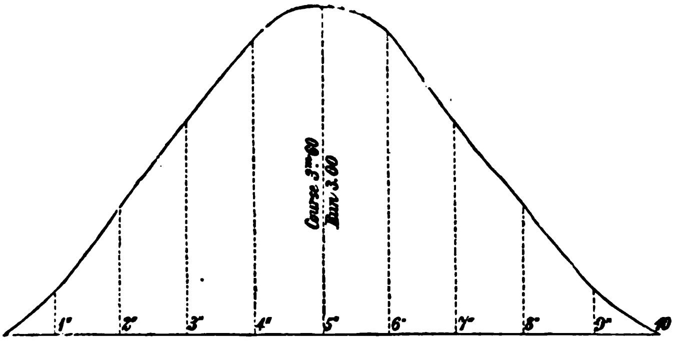
Let us suppose two man-engines, worked by these different engines, having a stroke of $3^{m}.00$ and making 6 double strokes per minute. The speed per minute is equal to $3^{m} \times 12$ strokes single $= 36^{m}$. Therefore, while the crank machine will take 60 seconds to go over these $36^{m}.00$, or a mean velocity of $0^{m}.60$, the single-acting engine will take 60 seconds diminished by 12 stoppages, which are generally of $2\frac{1}{2}$ seconds $= 30$ seconds; its speed must then be double—$1^{m}.20$. The diagrams annexed clearly indicate the difference that exists between the working of these two methods.

In these curves the abscisses represent the number of seconds from the beginning of an oscillation, and the ordinates the corresponding spaces passed over by a stage.

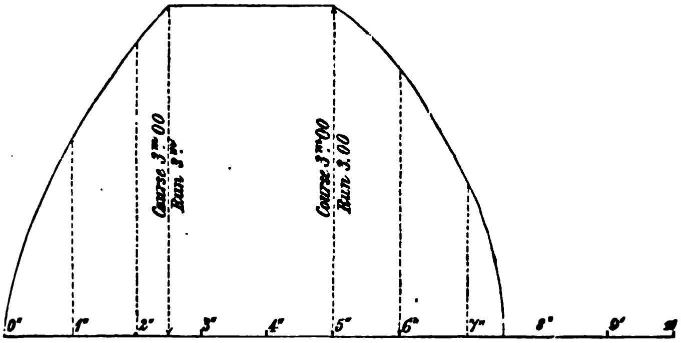
The machine with single action predominates in Belgium, while the crank machine is more used in Germany and England. The single-acting machines are generally placed directly over the shaft.

These engines are composed of two steam cylinders joined together;

the piston-rods are attached directly to the man-engine. The steam acts directly and alternately underneath or above one or the other of the pistons.



Working curve of the stage of a Man-engine when actuated by a double-acting engine.



Working curve of the stage of a Single-acting engine.

But there is an important condition to be observed, which complicates this arrangement a little. The platforms of the man-engines must have exactly the same velocity, and the strokes must terminate at exactly the same moment, so that both sets of platforms will be connected. This problem has been solved in two principal ways.

One method, designed by M. Hanrez, is to connect the rods by a pinion, as shown in the annexed figure.*

A strong rack is placed on each rod, and these work into opposite sides of the same pinion, steadied by an intermediate guide-rod. Uniformity of motion has thus been secured, for it is evident that when one rod descends the other must move simultaneously and equally. Every precaution has been taken by the constructor to prevent breakage. The teeth of the pinion and the racks are strong and carefully cut; and very few accidents have occurred.

The other method consists in extending the piston-rods through the upper cover of the cylinders, so that these two rods may be connected by a chain working over a pulley. They then necessarily move simultaneously. As a pulley working between the cylinders would have too small a diameter, two leading pulleys are placed over the cylinders surmounted by a larger one.

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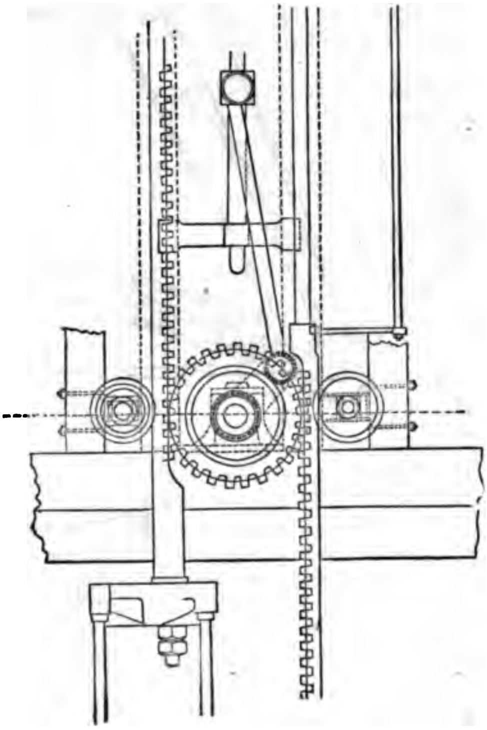
* From Plate L, *Matériel des Houillères*, Burat.

M. Haurez has also proposed to do away with the racks and pinion by the substitution of two balance-beams connected with a third and central balance. The plan of rolling up and unrolling chains over pulleys is credited to M. Colson.

When the motion is imparted, not by a direct-acting engine, as we have just been considering, but from the rotation of a crank, it is also necessary that the two rods should be connected together in order to secure an equal amplitude and speed of movement. Some of the principal methods will be briefly noticed. In general, balance-beams and varlets are worked together by a connecting rod, moved by another connecting rod, taking its motion from a gearing, the pinion of which is placed on the main shaft of the steam-engine.

The annexed figure will give an idea of this arrangement. To avoid the great expense incurred by these balances, Mr. Garffin suspends the rods to flat cables, which pass over leading pulleys, and are attached to the two extremities of a wagon rolling on rails and worked by a connecting rod moved by the engine.



Gearing of Man-engine Rods.

An ingenious arrangement by Messrs. Vaux and Guibal has been tried, but its utility has not yet been established by practice; but it is, nevertheless, worthy of being noticed.

Two cylinders are placed above the rods, as in the direct-acting engines. The engine gives motion to a strong pump without valves, which alternately forces and draws water from the cylinders over the shaft of the mine, thus alternately raising and lowering the pistons attached to the rods of the man-engine. The result is an alternate and opposed action of the rods. This plan would be excellent if the loss of water could be prevented.

M. Colson, at one of the reunions of engineers at Hainault, Mons, described some improvements which he had made in the form and construction of the rods.*

Instead of making the rods of a continuous piece for the whole depth of the mine shaft, which requires them to be strong enough at the top to carry the whole weight of the apparatus, M. Colson divides them into a certain number of small shafts, suspended by chains to pulleys, balancing themselves two and two. These isolated rods are much lighter than in the other construction. The principal rod, extending down the

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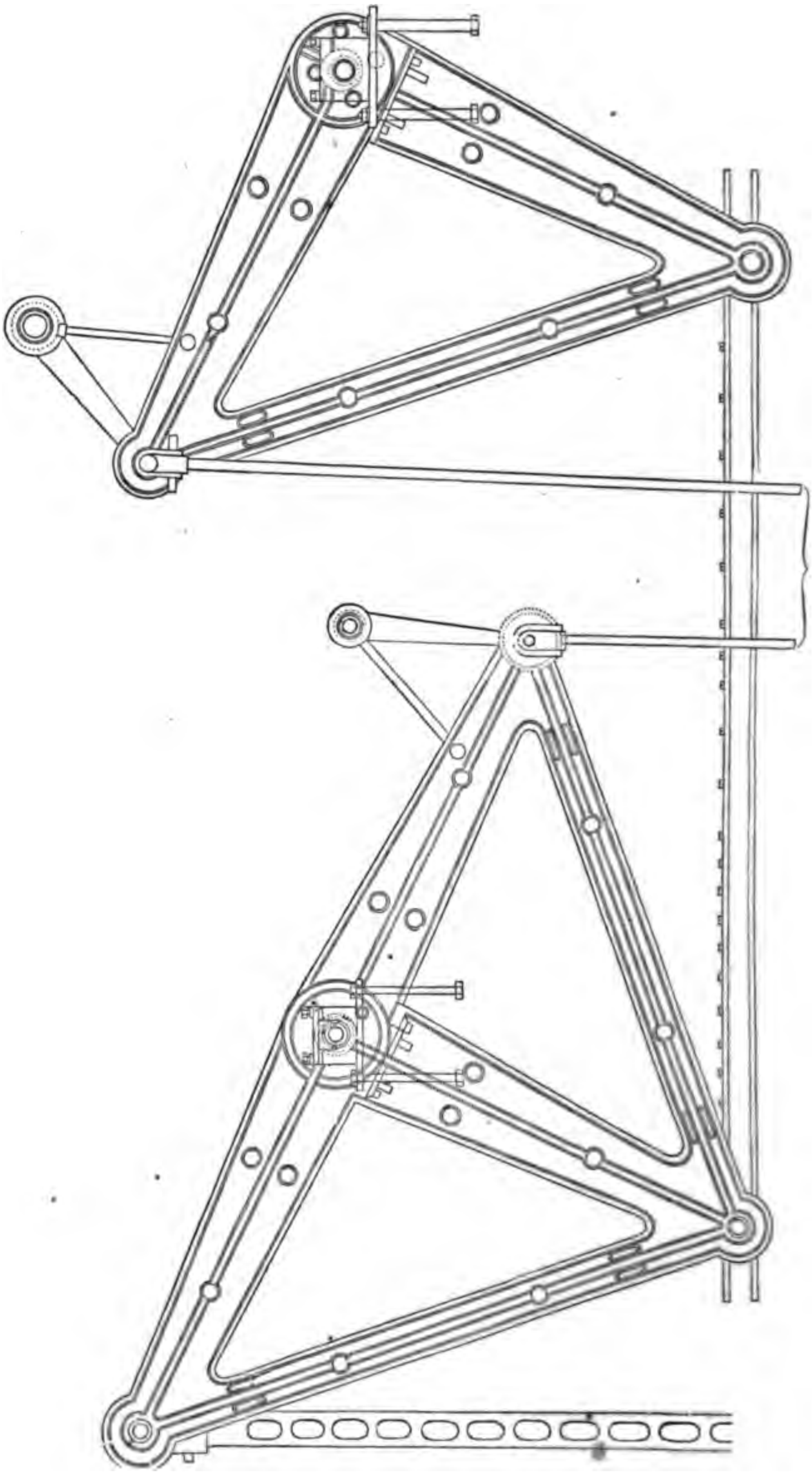
* Burat : *Matériel des Houillères.*



Arrangement for communicating motion to the rods of a Man-engine.

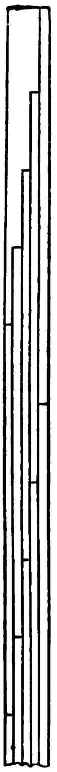
vhole depth of the mine, binds the small shafts together without supporting them; therefore its strength must be proportioned only to the train it has to overcome, which is very little compared with the strain n the man-engines with continuous rods. M. Colson gives a stroke of .0 metres, which he obtains by the alternate winding and unwinding of wo cables.

The velocity of movement until now, except in the Colson machine, ias never exceeded 50 metres per minute. The cost of construction 'aries considerably according to the construction, and, above all, according to the price of materials and labor in different countries. It varies etween 75 to 200 francs a metre for a depth of 200 to 500 metres. he engines made recently are nearer the lesser price, and hardly exeed the sum of 100 francs per metre.

The power required for the movement of the man-engine varies from en to fourteen horse-power for 100 metres of height. The amplitude of iotion, as already stated, varies from 2m.25 to 4m.00, but in Colson's rm it is from 10m.00 to 15m.00. In Cornwall, it is about twelve feet.

The rods.—The rods are either made of wood or of iron. Iron is ghter, with the same power of resistance, and requires less room.

Whether the rods are made of wood or of iron, they are all made ith a decreasing section from the top to the bottom of the appatus. The wooden rods are made in two ways—either of beams ljusted end to end, like the rods of lifting pumps, or they are made ith planks, the ends of which are stepped together, as indicated the annexed figure. Gradually, as the load to be carried allows it, a plank is left out so as to reduce the weight as much as posble, and yet retain all the necessary solidity.



Iron rods have been made in various forms, but generally in the iape of angle iron. The round or flat iron has the inconvenience allowing too much vibration, especially at the bottom.

The number of rods for each side of the man-engine may be one, vo, three, or four. The single rod is generally used in the inclined iafts. It is composed of a piece of wood running on rollers at bout six or eight metres apart. These rollers of wood or caston are laid on sills of wood fixed in the rock.

The stages or platforms are made of planks large enough to reive both feet, and are firmly supported by iron brackets below; on handles are securely fixed by bolts to the rods, at a height of bout 1m.00 to 1m.30 above each stage, to enable the miner to keep is balance.

Where the rods are separated by fixed ladders, as in some istances, the distance required to pass over from one stage to the ther varies from 0m.65 to 0m.75, which renders the apparatus in ommodious and even dangerous. The stages are sometimes made irge enough to carry two men at once, which permits the miners pass each other with ease in going up and down, some ascending hile others are descending; but in Freiberg the miners pass each ther without much difficulty on the small and single stages.

The landing places or stages.—The stages are made of the lightest wood ossible, and their dimensions vary according to the space at command; iey should not be less than 0m.50 to 0m.60 square; but some are made hich are only 0m.40.

But with these small dimensions they are dangerous. These stages e generally put in iron frames, which serve at the same time to bind ie rods. When two stages, one on the ascending, the other on the descending rod, are level with each other, the distance which separates them varies from $0^{m}.03$ to $0^{m}.25$, and even to $0^{m}.30$.

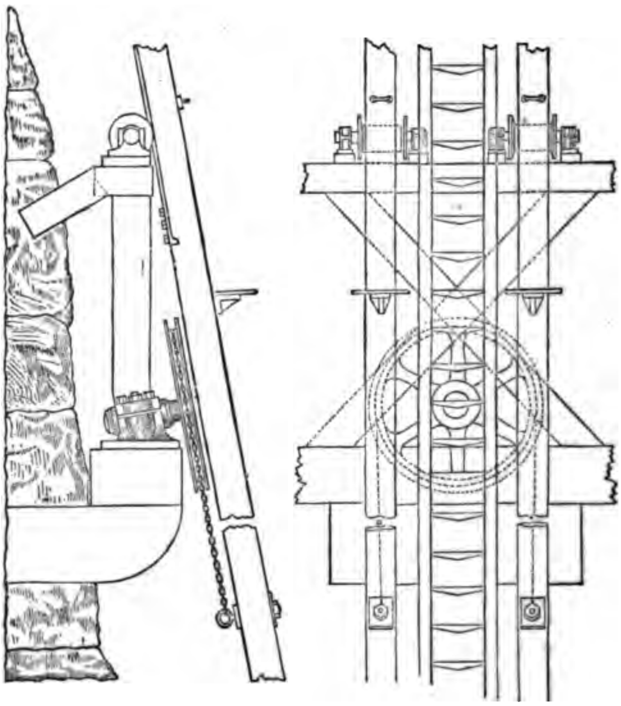
When the space is wide, there is danger in crossing from one stage to the other, for the miner may step into the empty space and be precipitated to the bottom. But if, on the contrary, the space is very narrow, the passage is very easy, but there is danger that the miner may imprudently let his head or his shoulder project beyond the stage on which he is, so as to be struck or caught by the stage of the opposite rod during the movement.

This difficulty is avoided in two ways—either by making the stage in two pieces, one fixed and the other hinged, so that it rises when it meets with an obstacle, or in fixing under each stage inclined planks, well dressed and smoothed, which push against an obstacle and force it back within the limits of the opposite stage. This last plan can only be used where the movement of the man-engine is not too rapid; if the motion is rapid, the first is preferable.

The hinges of the stages are made either of copper or of very strong leather to avoid oxidation. In the mines of Freiberg, Saxony, the stages are not placed opposite each other, but side by side.

Balance weights and pulleys.—The rods and stages work in guides at distances which vary from twenty to fifty metres from each other. But this is not sufficient. It would not be prudent to leave such a mass, 200 to 500 metres long, suspended without any other support.

The whole weight is therefore balanced by what are called balance pulleys. They are placed two and two alongside the rods. The opposite rods are then connected by chains, which pass over these pulleys and thus sustain a part of the weight of the rods. The weight of one rod also counterbalances the weight of the other. Adjusting screw rods at the ends of the chains give the means of changing the length of the chain so as to secure the proper strain on each support or pulley. The arrangement of the rods, the central ladder-way, and the balance pulleys and chains, are shown in the annexed figure.



Support of the rods of the Man-engine in an inclined shaft.

The hydraulic balance has been tried for the same purpose. It is composed of two pistons: one is placed on the first set of rods, the other on the second. To these pistons two amp-barrels correspond, connected with each other by a pipe giving ee communication. The descending set of rods, taking the piston ith it, forces the water into the other pump-barrel, and as the water has o outlet, it forces up the other piston, lifting the other set of rods with it.

The hydraulic balance would be very good if the packing of the pis- n could be kept tight. Unfortunately it cannot; water is lost, and en the descending piston does not transmit its pressure to the rising iston before some part of the stroke is lost, so that the balance is dis- rbed. It has been abandoned for this reason. When the man-engine single-acting—that is to say, where there is not more than one rod d the other rod is replaced by a line of fixed stages—the rod must be lanced to prevent the shock it would receive at the bottom by the petus gained during its descent. This balance can be obtained by ains attached at different heights of the lift, passing them over pulleys tached to the rock and attaching to their ends counterpoises of suffi- ent weight. Such an arrangement is very dangerous from the liability the chains to breakage.

In England such pulleys are replaced by beams carrying balance eights; but although this arrangement is safer, it is much more expen- ve. The stroke, always a long one with a man-engine, requires beams large dimensions, and they cannot be lodged in the shaft without aking very large excavations in the rock, which are very expensive.

Hydraulic regulators.—To regulate the descent, a hydraulic regulator brake is also used. It is a pump furnished with a suction-valve, and e outlet of the pump is furnished with a tap. The piston of this pump fixed to the shaft of the lift; when this latter rises the pump fills with ater; when the piston falls the water can only escape by the small ening, and the issue can be regulated by the tap. The rapidity of scent may thus be varied at will.

Operation of the man-engine.—We may now compare the different ethods for the ascent and descent of miners, and note the great saving time and strength resulting from the use of the man-engine.*

To go down 100 metres of ladder requires about 15 minutes, (900 conds,) equal to 9 seconds per metre. If we suppose that the men llow each other at 2 metres distance, after the first man has arrived the bottom of the shaft it will be 18 seconds before the second man ts to the bottom, and so on; so that, if the shift is composed of 200 en, it will require 900 seconds + (200 × 18 seconds) = 900 + 3,600 conds = 4,500 seconds, or 1 hour 15 minutes, for them all to descend the bottom.

If the shaft is 400 metres deep, 15 minutes per 100 metres must be ded for the descent of the first man, which makes altogether 2 hours r 200 men. With this basis for calculation it is easy to find the time quired for the descent of any number of men to any given depth.

The ascent of 100 metres of ladder requires about twice as much time the descent; then, if we take the depth of 400 metres, and the num- r of men 200, we have for the descent by ladders 2 hours, and for the cent 4 hours—in all 6 hours, which, added to 8 hours' work per shift, akes 14 hours, during 6 hours of which the work in ascending and scending is much harder than the actual mining.

It is impossible for men to continue to perform such labor, so that in ost mines over 250 metres deep the hours of real work are shortened d the balance of the time is set apart for the work of ascending and scending.

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* This comparison as well as other details respecting the man-engine are taken from Exposition reports.

The Polytechnic Society of Cornwall, in comparing the rate of mortality among men working at different depths, (accidents deducted,) estimates that in works of 400 to 500 metres in depth, where ladders are used, the lives of the men are shortened by twenty years. However this may be, it is certain that the prolonged use of ladders gives rise to serious derangements of the organs of respiration, and renders a certain number of men unfit for work before they are thirty years old.

The time required for lowering and raising a shift of men by cables is not as easy to estimate as that required where ladders alone are used. It depends, in fact, on two variable elements—the rate of speed, and the number of men that can be lifted at each time.

The rate of speed varies according to the importance of the workings; in shafts without guides it is often from one to two metres per second; in shafts provided with guides and cages, it is from three to twelve metres per second; but when the men are taken up and down in the cages, the speed is often slackened, keeping it about three to six metres per second. The number of men carried at once is from two to three in the small workings, and sixteen to twenty, or more, in mines of greater extent.

A comparison of the time required for the descent by ladders and by lowering in cages may be made as follows: Assuming that there are 200 men in a shift and that the depth is 400 metres, the rate of speed, averaging, say five metres, and that eight men are carried at once—at five metres per second, to ascend or descend 400 metres requires $\frac{400}{5}=80$ seconds. To this must be added about two minutes (120 seconds) for the stepping in and out of the men, and the starting and stopping of the engine, which makes altogether $120+80=200$ seconds. Lowering 8 men at once, we have $\frac{200}{8}=25$ journeys in all for the shift; the time will therefore be 25×200 seconds$=5{,}000$ seconds$=1$ hour 24 minutes. Doubling this for the entire time in going into and out of the mine, will be 2 hours 48 minutes, which is half the time taken for the ascent and descent of the same number of men by ladders. But these figures are not absolute; they may vary widely, either more or less, according to the extent of the workings.

The advantages and disadvantages of the rope are inversely to those of the ladders; the health of the men does not suffer, but there is less security, and accidents are much more serious.

Accidents by ropes and by ladders are as 3 to 2; but this ratio is still increased by the fact that of 100 accidents to men, 94 are killed and 6 injured.

These deplorable consequences from this method of transportation of miners caused the Prussian government to prohibit the lowering or raising of men by the cages in the mines of Prussia.

In order to estimate the time required for the ascent and descent of miners by the man-engine, let us take our standard example, 400 metres of depth, and 200 men to send down or lift up for each shift.

Allowing the stages to be 6 metres distant from each other, and the man-engine to make 6 double strokes per minute, in one minute a man will then have passed upon and from 6 stages; he will then have been lifted $6^m.00 \times 6=36^m.00$, and consequently will rise the 400 metres in $\frac{400}{36}=12$ minutes, in round numbers. Each double stroke thereafter will deliver another man at the surface, or, which is the same thing, the machine will lift 6 men per minute; the 200 men will therefore arrive at the surface in $\frac{200}{6}=34$ minutes in round numbers, which, added to the 12 minutes required for the whole ascent of the first man on the stages, gives in all 46 minutes; doubling this for the lowering and lifting of one shift of men, and we have 92 minutes (1 hour and 32 minutes) for the whole, and that without either danger or fatigue. So that for 200 men and 400 metres of depth, the ascent by ladders requires 6 hours; by hoisting, varying from 1 to 4 hours; by the man-engine, only 1½ hour.

The fitting up of a man-engine is doubtless a considerable expense, but it is soon repaid by the time saved, and the prevention of muscular fatigue of the miner.

For further details respecting the construction and working of man-engines reference may be made to the following-named works, from which a part of the information here presented has been compiled: Burat's Materiél des Houillères; Portefeuille de Cockerill; Zeitschrift des œsterreichischen Ingenieur-Vereins, 10ter Jahrgang; Annales des Travaux Publics de Belgique, vols. 4 and 6; Annales des Mines de France, 5me, vol. xv; Revue Universelle, vols. iv, v, vi, xiv, xvi.

CHAPTER LXXVI.

VENTILATION.

Very few of the mines of the West are so deep and extensive as to require any elaborate and extensive contrivances for their proper ventilation. In most cases, their position and construction are such that a current of air circulates spontaneously through them by reason of one of the openings being at a greater altitude than some other, as, for example, one or more shafts with tunnels leading to them from the hillside. If the air in the mine is warmer than that outside, it rises in the shaft, and is replaced by the influx of the colder air through the tunnel. But the conditions essential to ventilation in this way are not always found, and it becomes necessary to resort to artificial means to supply the miners at the extreme points of the mine with fresh air. In driving long tunnels, especially where powder is used, the air is rapidly vitiated, and soon becomes unfit to breathe.

There are two ways in which ventilation may be effected, either by *drawing* the impure air out, or by *forcing* pure air in. A good example of the first-named method was presented at the Latrobe tunnel, Virginia City, which was driven for the greater part of the distance without a ventilating shaft, one only having been sunk not far from the entrance. Tin pipes were first used to convey the air and were placed along the top of the tunnel extending from a few yards back of the face to the bottom of the air-shaft. But it was found difficult to maintain a good draught, and the metal pipe was replaced with one of wood, made of boards about eight inches wide, and rabbeted so as to form tight joints. With this arrangement no difficulty was experienced; the heated air at the end of the tunnel escaped constantly through this tube and rose in the shaft, while the pure air from the outside flowing in at the mouth of the tunnel took its place. In this instance it was evident that the non-conducting quality of the wood prevented the air from becoming cooled in its passage before it reached the shaft.

The method of producing a draught by means of a fire or by connecting the ventilating pipes with the ash pit of the furnace fires is well known and is often resorted to on a small scale in California.

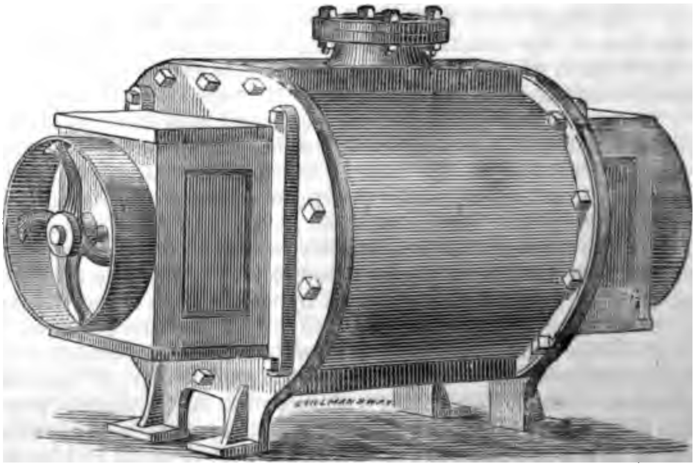
The only example of mechanical ventilation worthy of special mention which came under the writer's observation in California was at the Princeton gold mine, Mariposa Estate. Foul air was generated to such an extent in the southern part of the mine that it could not be entered. A simple centrifugal fan-wheel, about ten feet in diameter and two feet wide, was erected over the nearest shaft. This fan-wheel was not inclosed, but revolved between two vertical temporary walls of boards, thus leaving the arms and fans fully exposed to view. The mouth of the shaft was tightly closed, excepting two openings connected by box tubes with large openings in the walls of boards, around the axis of the fan-wheel. When this wheel was put in motion by a band from the engine, it produced a strong current of air up the shaft, and cleared the workings of foul air in a short time. It was evident that a much smaller blower would have answered the purpose.

For *forcing* pure air into tunnels and drifts of slight extent an ordinary wind-sail or a fan-wheel driven by hand or attached to the horse-whim is usually employed; but these, of course, from their want of forcing power, are not very effective. The object in using them in most cases is not so much to supply pure air as to give a cooling current or blast of air near the workmen.

In several of the mines upon the Comstock lode, the "Indiana Blower," Root's rotary compression blower, is used with great success in ventilating. Mr. James G. Fair, superintendent of the Hale and Norcross Silver Mining Company in March, 1869, had the blower in constant use, day and night, since its adoption by the company in August, 1868. Although of only medium size, it supplied sufficient air to enable them by the use of branch pipes and dampers to prospect simultaneously at different depths, and at considerable distances apart upon the same level. It furnished air to two gangs of miners in separate drifts on the 1,030-foot level, and partially ventilated the level 100 feet above that, and with but a portion of the power the blower could have utilized.

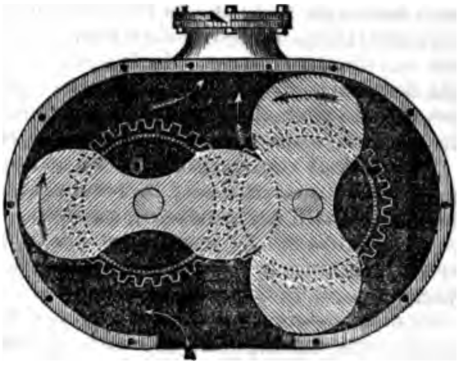
The Potosi Company have had a No. 2 blower for ventilating the levels below the 900-foot station; and they have been successfully used upon the Yellow Jacket mine since the great fire. Mr. Winters, the superintendent, in August last, in a letter to the agents, said, "I have great pleasure in stating that they work admirably. If we had been without them, it would have been quite impossible to work our mine since the great fire in this and the adjoining mines."

This blower gives a "positive" or force-blast, taking in and forcing forward a definite quantity of air at each revolution. Its construction is shown by the figures annexed.



Root's Rotary Compression Blower—exterior.

he first figure shows the external form of the case, and pulleys at h end for the reception of driving-belts. The cross-section of the rior shows the inlet and outlet and the form of the arms or wings. case is usually made of cast- , with the cylindrical parts ed out, and the head-plates d off truly upon a boring- , arranged for the purpose. friction is confined to the nals and cog-wheels. The s or wings do not touch in ning, but move as closely to- er as possible without being ally in contact. They are ut two feet long and make n 100 to 300 revolutions a ute. A machine exhibited he Paris Exposition was said roduce a pressure equal to third of an atmosphere, or five pounds to the square inch, when en at the rate of 250 turns per minute.



Root's Blower—cross section.

the coal mines of Pennsylvania more and more attention is now n to ventilation, as not only the ordinary difficulties of working, also the liability to accumulations of dangerous gases increase with depth of the mines. The different systems of natural and artificial tilation, including the use of the furnace, steam-jet, and blower, have vigorously discussed during the past year or two by Messrs. Roth- and Harden, mining engineers of Wilkesbarre, in the columns of New York Engineering and Mining Journal. The latter gentleman ns to esteem the furnace more highly than the former, who in most s prefers fans. The arguments on both sides were interesting and able; and those directed against the furnace were emphasized tly afterward by the terrible catastrophe at Avondale, where appa- s of this kind set fire to a column of gas and burned the brattice of shaft and the breaker over it, closing the only entrance to the mine sacrificing a large number of lives. A fan has been substituted for furnace at Avondale; yet under some circumstances a fan is in- r. For instance, when a fan is disabled or interrupted its effect es at once. Thus, at some critical moment in a mine, or in some fiery mine, where every moment is a critical one, the fan ventila- might instantly and totally cease, while a furnace, though neglected terrupted, would continue to act, though with diminishing effect, ours. The precaution of maintaining a duplicate fan always in rve is calculated to remove the objection.

MECHANICAL VENTILATION OF MINES ABROAD.

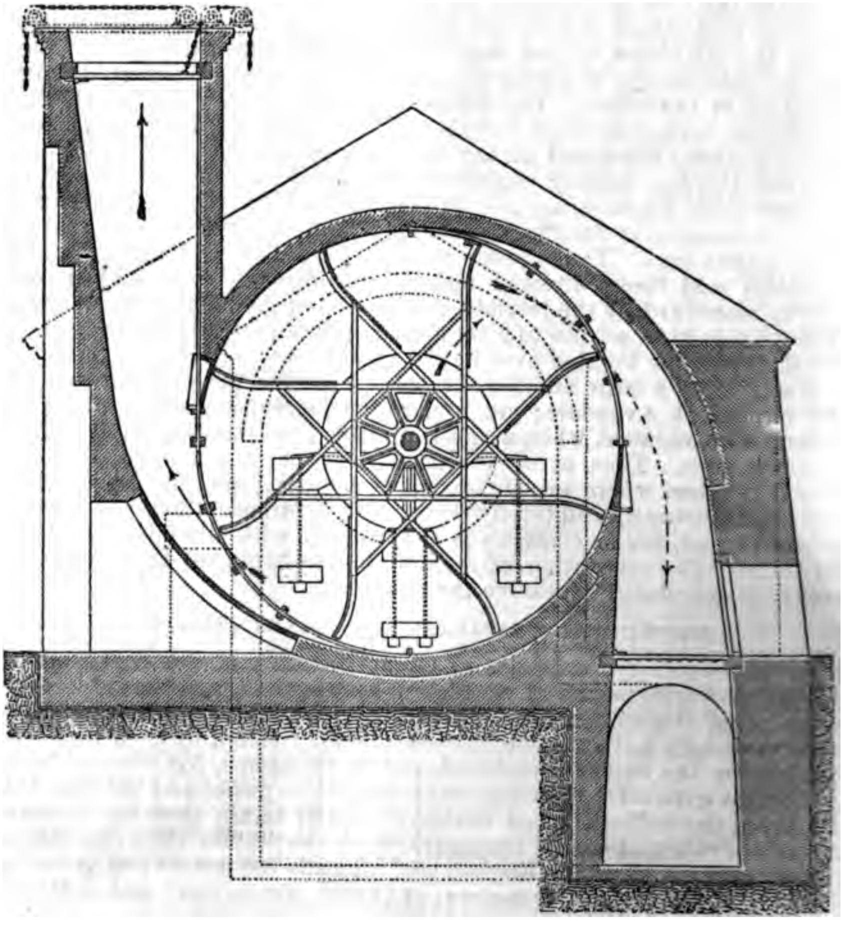
r the extensive collieries of Great Britain and the continent of pe powerful means of ventilation are required, and the subject re- es great attention among mining engineers and constructors. The rs not only have to contend with the air vitiated by their own res- tion, by the animals employed, and by the lamps, but the coal beds selves give off large volumes of deleterious gases, and the dreaded lamp, the collier's great destroyer. Coal mines therefore require elaborate and costly preparations for ventilation than any other. e mean depth of the English coal mines is 180 metres; of those in ium, at Charleroi, 360 metres; at Centre, 350 metres; and at Mons, metres.

A few years ago nearly all the important collieries of England were ventilated by means of furnaces placed near or at the bottom of ventilating shafts, by which the air was rarefied and made to ascend. In such furnaces, from ten to twenty tons of coal were burned daily. This required large furnaces and costly excavations, and galleries of large size for the air-courses. In Belgium and France mechanical ventilation has been carried to a great degree of perfection. This system is said to be well established by experience as much cheaper and less dangerous than the use of furnaces, and is gradually replacing the furnace ventilation.

Mechanical ventilators may be grouped in three classes: 1, centrifugal ventilators, or fans; 2, rotary pumps, or force-blowers; 3, piston machines, with reciprocating motion.

Ventilators of the first class are of great dimensions, capable of delivering immense volumes of air. They have been in use for about thirty years, and have undergone many changes and improvements. Like most other ventilators, they act by aspiration, producing to a certain extent throughout the mine a lower barometric pressure than is found in the external air. This depression varies in general from five to seven centimetres of water.

Guibal's ventilator.—Guibal's ventilator, after having undergone many



Guibal's Ventilator—section.

changes and improvements through a series of years, is now most in favor. It is made with a diameter of 7 to 9 metres, and is inclosed for three quarters of its circumference. The other quarter has a movable valve, so that the size of the delivery opening can be varied at will. The air of the mine is received by a central opening, of which the diameter is equal to that of the shaft, and it is thrown out through a vertical chimney, the sectional area of which increases as it ascends, in order that the current may enter the outer air with a progressively reduced velocity. These ventilators are also used to throw air into the mine by reversing the current.

The construction shown in the section is that of the ventilator established by M. Guibal at the Blanzy mines. It has two chimneys, one for delivering the air from the mine upward, and the other for a reverse movement when it is required to take the air from the surface and force it downward into the mine. In this case a valve or door at the top of the chimney closes the opening, and when the fan is used to throw the air out of the mine the reversed chimney is closed by a similar door. This form of ventilator was formerly made open without an envelope or outer case; but it was soon found that much of the power was lost by re-entering currents of air.

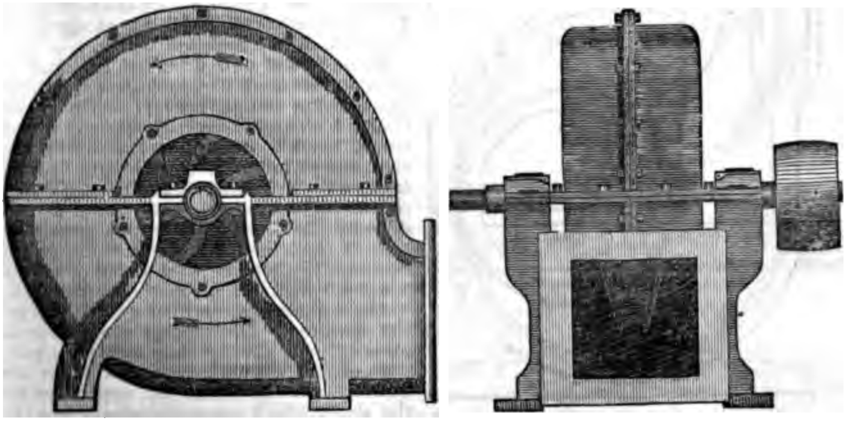
In 1862, M. Guibal sent to the London Exhibition the plan of a ventilator capable of displacing 100 cubic metres of air per second. This required a fan nine metres in diameter and four metres wide.

The engineers of the Blanzy mines, guided by a long experience with Duvergier's ventilator, have adopted a machine with the axis vertical. The fan turns in a pit lined with masonry and covered over. The air is drawn in from below and is thrown out through an opening to a chimney at the side. It is about 30 feet in diameter, and is known as the Audemar ventilator.

FAN-BLOWERS.

To this same class of ventilators belong the great variety of the ordinary fan-blowers, and it will be sufficient for the objects of this notice to mention only one or two of these, which have been used to some extent in mining.

Lloyd's noiseless fan.—Lloyd's noiseless fan, an end view of which is shown in the figure, consists of a hollow drum, made of two cones of thin metal, and divided radially by curved partitions, extending from



Lloyd's Noiseless Fan.

the axis of revolution to the periphery. Its construction much resembles that of Appold's pump. The air is taken in by openings at the centre around the shaft, and discharged between the partitions at the circumference. It is made of various sizes, from thirteen inches to four feet in diameter; the smallest are run with the velocity of 1,800 to 2,000 feet per minute, and the largest 800 or 1,000. When used as an aspirator in mines, the surrounding box is not required.

Schiele's fan.—Schiele's compound blowing fan consists of two fans resembling Lloyd's, and acting successively upon the same air. The first fan drives it into a chamber between the fans at a pressure of about six ounces; the second compresses the air still more, so that at the delivery pipe it has a pressure of about twelve ounces per square inch. A ventilator upon this principle was used in the ventilation of the Exposition building at Paris, 1867.

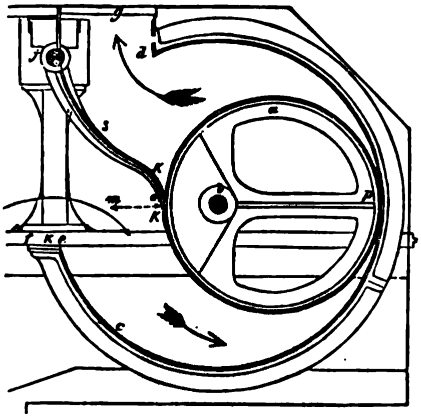
It is well to note here that for the purposes of aspiration of air from mines, where great volumes of air are to be moved at a low velocity, and through large galleries and drifts, the large centrifugal blowers or fans are well adapted; but for forcing air in through narrow pipes or conduits, where large volumes cannot pass, velocity and pressure are required. and for this purpose the compression or force-blowers of the second class are preferable..

ROTARY COMPRESSION VENTILATORS ABROAD.

Of the second class, the rotary compression ventilators, Fabry's and Lemielle's appear to be the most used. Fabry's consists of two interlocking wheels, with three arms, the extremities of which are in the form of a cross, with epicycloidal arcs, the surfaces of which, coming in close proximity or contact with each other, carry forward a volume of air equal to the inclosed spaces at each revolution. These ventilators are generally 1^m.70 in diameter, and from 2^m.00 to 3^m.00 long.

Lemielle's ventilator.—Lemielle's ventilator revolves horizontally. For 20 to 25 revolutions per minute, and a delivery of 30 to 40 cubic metres of air a second, the diameter should be 7 metres and the height 5 metres.

Cooke's ventilator.—Mr. Cooke, of England, has recently proposed a ventilator of the same class. It is described in "Engineering," from which I condense the following description:



Cooke's Ventilator.

> The machine is of a size suitable for a 1,000-feet pit, and it is intended to yield, per minute, 180,000 cubic feet of air, with an exhaustion equal to 3 inches of water; or 150,000 cubic feet, with an exhaustion of 4 inches; or 120,000 cubic feet if the drag is increased to 5 inches of water.
>
> It consists of two drums, *a*, each 8 feet in diameter and 16 feet in length, these drums being mounted eccentrically on the shafts *l*. The amount of eccentricity of each drum is 2 feet, and each as it revolves thus moves in contact—or almost in contact—with a cylindrical casing, *c*, of 6 feet radius. The casings, *c*, are closed at the ends by the brick walls which form the side of the apparatus, these walls being coated with plaster over those portions against which the ends of the drums, *a*, work, and being connected at the top by the covering. The casings are not complete cylinders, each being open for a portion of its circumference, *d e*. The air from the mine is led to the apparatus by the shaft, which communicates with the space surrounding the casings, and it is

drawn into these casings, and finally discharged at openings by the action of the revolving drums, *a*, in a manner which we shall now proceed to explain.

The portion of the casing left often is closed by a vibrating arm or "shutter," *s*, hung by the upper edge at *j*, and the lower edge of which is kept closely in contact with the surface of the revolving eccentric cylinder by means of an arm keyed upon a prolongation of the shaft *j*, beyond the side of the machine.

Each arm is 6 feet long between centers, this length corresponding to the distance between the center of the shaft, *j*, and the center, *m*, from which the curve of the lower part of the shutter, *j k*, is struck. In fact the center of each arm agrees exactly in position with the center, *m*, to which it corresponds. On one end of each of the main axles, *b*, is fixed a crank, each crank having a 2-foot throw, and the center of its crank-pin exactly corresponding in position with the center of the eccentric drum on the same shaft. Each of these cranks is connected by a link to the end of the corresponding rocking arm, and as the length of this link is equal to the radius of the drum, *a*, added to the radius *m o*, of the lower part of the corresponding shutter, *j k*, it follows that each shutter is kept in constant contact with the drum to which it belongs. The lower edge, *k*, of each shutter sweeps over a curved surface of plaster, *e f*, this plaster, which is held in a hollow casting as shown, enabling a sufficiently tight joint to be made very readily.

The action of the apparatus, which we can best describe by considering the motion of one drum only, is as follows: When the moving parts are in the position directly opposite to that shown in the section, the communication between the interior of the casing, *c*, and the space surrounding it is closed by the shutter, *j k′*; but as the drum, *a*, moves round in the direction of the arrows, the lower end of the shutter, *j k*, gradually approaches the shaft, *b*, and a space is thus opened between its lower edge, *k*, and the edge, *e*, through which the air can enter the casing, *c*, this opening reaching its maximum area when the parts are in the positions shown. As the drum continues its motion, the shutter, *j k*, returns again toward the position, *j k′*, and the air which has entered the casing is swept round to the discharge opening, *g*. The curved surface, *e f*, is made of such length that the lower edge, *k*, of the shutter keeps in contact with it during the time that the point, *p*, of the drum, *a*, (the point of greatest eccentricity,) is passing between the points *d* and *e* of the circumference of the casing—and in fact somewhat longer—thus preventing any back leakage.

The two drums, *a*, are so connected to the engine as to be moving always in contrary directions. One reason for this is, that the air contained between each drum and the interior of its cylinder is nearly a complete crescent, and consequently much smaller at the horns than in the middle. By having a second drum working at the horns when the first is working at the middle of its crescent of air, the two drums are made together to give an equable stream of air in the shaft. A second reason for adopting this plan is, that convenient sizes for mine ventilators are apt to be too long, and if the weight is to be divided this plan admits of the convenient disposition of the engine, while, at the same time, doubling the bearings of the machine. A third reason is, that although the drums are perfectly balanced as respects their own rotation, there remains the reciprocation of the shutters and their levers and connecting rods, which, instead of introducing vibration into the machine, are by this means made to compensate each other through the girders upon which they respectively act. A fourth reason, not unimportant in large machines, is, that the shutter as adopted in the plan (the small weight of this shutter being as much as possible concentrated near the axis, so as to assist its pendulous action, and diminish as much as possible the travel of its center of oscillation) has the pressure of the air on one side only, and consequently puts a certain strain upon its connecting rod, which, by this duplicate arrangement, exactly counterbalances that upon the connecting rod of the other machine, the strain of course passing through the side rods from one drum to the other. When the machine is not duplicated it is proposed to place a balance weight near the axis of the shutter, at the same time partially balancing the pressure of the air, and making the shutter vibrate more in harmony with the revolutions of the drum. The next thing to be observed is that the opening on the top of each machine is equal to the extreme opening of the shutter into the cylinder internally. The machine whose shutter is in this position is at its greatest work while the shutter of the other machine is closed, and consequently no work is for a moment going on there. It will also be noticed that the openings which have been spoken of are much greater than half the area of the shaft to which the machine is applied. This is to avoid giving the air a higher average velocity in any part of its passage through the machine than that prevailing in the shaft. The machine acting on the thick part of the crescent doing much more than half the whole work then going on, the opening has been proportioned, so as to realize the required velocity.

The shafts, *b*, are provided at one end with cranks, which are coupled to a crank of equal throw fixed at the end of the crank shaft of a horizontal engine placed by the side of the apparatus. The motion is thus communicated from the engine to the drums in the same manner as the coupled wheels of a locomotive are driven, a simple arrangement which will no doubt be found to work well. The arrangement also allows either

> drum to be disconnected, when it requires to be stopped, without necessitating the continued stoppage of the other. This advantage is sufficient in fiery mines, at least, to justify the precaution.
>
> We think that the particulars we have given of Mr. Cooke's ventilator will show that the machine possesses many features that render it entitled to the careful attention of those interested in mine ventilation. The apparatus consists of but few parts, and those are all of simple construction, and are subjected to nothing more than very ordinary wear and tear. The eccentric drums are of sheet iron, $\frac{3}{32}$-inch thick, supported by cast-iron eccentrics, which also form the balance weights. The casings in which the drums work are also of sheet iron $\frac{1}{8}$-inch thick, stiffened by ribs; while the side walls of the apparatus are of brick, and have cast-iron columns built into them to support the plummer blocks. As the drums revolve barely in contact with the casing and flaps they will be subjected to little or no wear so long as the bearings of the shafts, &c., are kept properly adjusted, and these bearings being all fully exposed to view there is no reason why they should be neglected. Indeed, one of the great practical advantages of the arrangement is that all the wearing parts are completely open for inspection.

Upon the performance of this blower in model, "Engineering" remarks:

> This model represented, to the scale of 1 inch to the foot, the ventilator we illustrate, and it was tested against a 25-inch Lloyd's fan, by employing an engine to drive the model and fan alternately, full steam being admitted to the engine and the boiler being kept blowing off in each case. Under these circumstances the maximum pressure against which the fan was found to deliver air was equal to 9¾ inches of water, while Mr. Cooke's ventilator blew well against a pressure of 22 inches, beyond which the engine power was insufficient to drive it. In another experiment the model, although driven through a belt and gearing, was found to utilize 78 per cent. of the indicated power of engine when exhausting against a drag of 6 inches of water. This is a very high duty, all things considered, but at the same time we see no reason—judging from the construction of the apparatus—why an equally good result should not be obtained from the trial of the machine on a large scale. The fans which have been applied for ventilating purposes have been found to yield an effective duty of from 40 to 55, or in some cases nearly 60 per cent. of the power applied; but the efficiency, even of the best fans, varies very materially at different speeds and under different circumstances, and, moreover, unless used on the duplex system—that is, one for receiving and condensing the air delivered by another—they cannot be conveniently worked against high pressures. Mr. Cooke's ventilator, on the other hand, appears well adapted for working against much higher pressures than are ever wanted for mine ventilation, and we believe that in a slightly modified form it might be advantageously employed for supplying blast to cupola furnaces and for similar purposes.

Root's compression blower.—Root's compression rotary blowers, in use in our mines, and already described, belong to this class, and for simplicity and effectiveness compare favorably with either of the above.

Evrard's blower.—Evrard's compression blower may also be noticed here. It is constructed upon the same principle as the rotary steam-engine of Breval. Two cylinders of equal length, and whose radii are as two to one, revolve in contact, one rolling upon the other, except where two cycloidal indents in the smaller cylinder receive in succession each of four projections or pallets upon the larger.

Thirion's hydraulic pressure blower.—Of the third class—machines with a reciprocating movement—Thirion's hydraulic pressure blower is worthy of special mention; and this notice I extract from the report of President Barnard:*

> Still a third compression ventilator appeared in the Exposition, which, for its simplicity and its originality, seems to merit notice. It is called by the exhibitor, Mr. Thirion, of Mirecourt, France, a *machine soufflante à colonne d'eau*, but the water referred to in the name served no other purpose but to pack the moving parts and prevent friction. The figure annexed will serve to render the construction intelligible.
>
> Three cylinders are here seen, side by side. The two lateral ones are the compressors, and the middle one the regulator. One of the compressors is shown in section. A is a cylinder of wood or sheet metal, as may be convenient, bolted to the base which sustains the whole. Within this is another cylinder, and between the two is an annular space which may be filled to any level desired with water. The water level in the figure is shown at O. Between these two cylinders is suspended an inverted cylinder.

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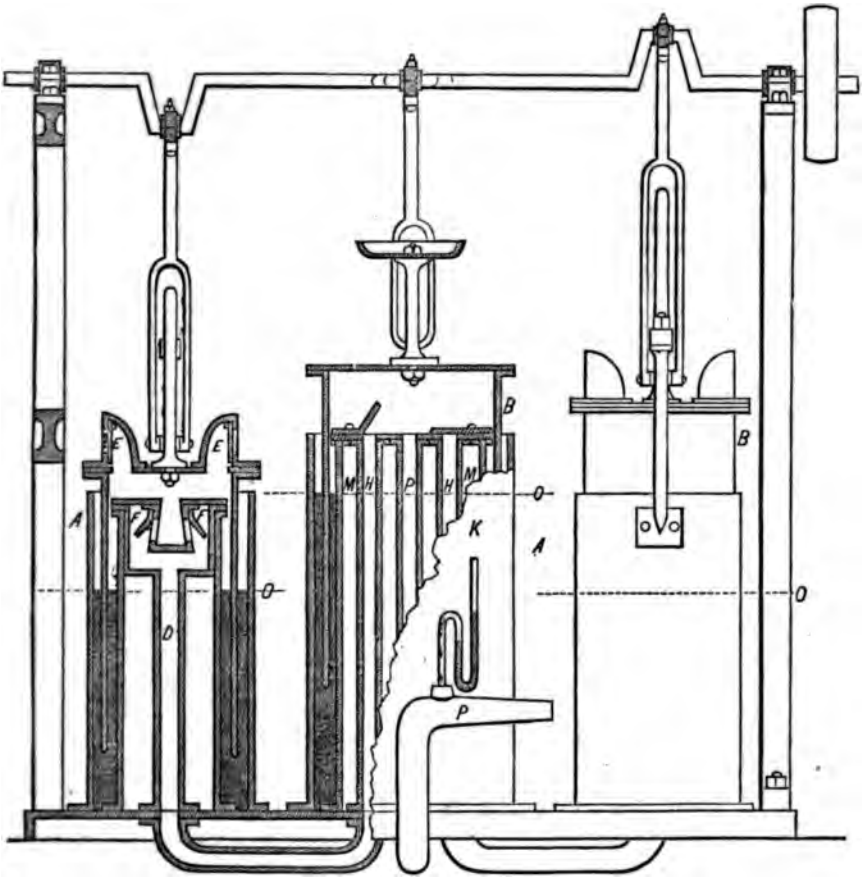
* Machinery and Processes of the Industrial Arts, pp. 193–196.

or cylinder open downward but closed at top, which enters the annular space between the two cylinders first named, without touching either. In the top of this suspended cylinder are two valves, E and E, which open inward. A cap is placed on the central cylinder within, and in a valve-box beneath this are two other valves, F and F, which open outward as shown. From the closed space into which these valves open descends a pipe D, which communicates beneath the base by means of the recurved and rising tube H, with the regulator. The action of the machine will now be easily understood, it being observed that the regulator is constructed on the plan of the compressor so far as that the cylinder B, which is closed above and open below, descends into an annular space containing water, like the suspended cylinder of the compressor. The cylinder B, however, is not suspended, but is simply kept in an upright position by a guiding rod proceeding from the centre of its crown. It has also a scale pan above it to receive pressure weights, and should have a safety valve, though none is shown in the figure. The movable cylinder of the compressor is suspended from a crank or eccentric on the driving shaft of a prime mover. As in the revolution of the shaft the cylinder is lifted, air enters by the valves E, which spontaneously open. As the cylinder descends the valves E close, and the valves F are opened by the pressure of the contained air which is condensed by the force of the motor. The condensed air then finds an escape through D and enters the regulator through H. At the top of H is a valve which is represented as raised by the entering currents. The cylinder B rises to give room for the entering air, the pressure remaining constant and being dependent on the weight with which the scale pan is loaded. The second compressor acts alternately with the first; so that a stream of air is constantly entering the reservoir from one or the other. A tube, P, from the centre of the regulator, descending below the base, conducts the blast to the



Thirion's Hydraulic Pressure Blower.

point where it is needed, and where it is delivered through a tuyere, P. A siphon gauge attached to this tuyere shows the pressure of the air at the efflux. Of course, as the pressure is increased, the level of the water within and without the movable cylinders, both of the compressors and of the regulator, will become unequal; and the maximum pressure attainable will be only equal to the vertical height between the top of the fixed cylinder A and the bottom of the movable cylinder when at its highest point. If the water in A is in too great quantity to admit of such a pressure, it will run over until the pressure is attained. If it is in deficiency, the maximum cannot be attained, but the air at some pressure inferior to the maximum will begin to escape from beneath the bell. These statements are founded on the supposition that the suspended cylinder, or bell, divides the annular space into which it enters equally. Greater pressure may be obtained by the use of a liquid heavier than water; and, for powerful blasts, Mr. Thirion proposes to employ mercury. With water he obtains a pressure of ninety-five centimetres, (about three feet,) or say a pound and a half to the square inch. Substituting mercury, there might be obtained, with half the difference of level, two-thirds of an atmosphere. The pressure of a pound and a half, however, is about four times that which is furnished by a good ventilating fan, and higher than is commonly used in cupola furnaces.

This machine has four very decided recommendations. It works almost without friction or leakage; the deterioration by wear is inappreciable; the perfect and exact regulation of the pressure is easy; and finally, the excellence of its performance depends in no degree upon precision of workmanship. It is a machine, therefore, which is especially adapted to the exigencies of furnaces in new countries and among the mountains, since it can be easily constructed on the spot, and will give no trouble in consequence of derangements.

CHAPTER LXXVII.

SAFETY LAMPS, AND FIRES IN MINES.

As connected with the subject of ventilation, the following notices of the principles upon which safety lamps depend for their efficacy, and of the construction of those most used, have been prepared:

In the common Davy lamp the flame is surrounded by a cylinder of black iron-wire gauze, with 28 apertures to the linear inch. This cylinder is firmly set in a brass ring which screws upon the top of the oil-vessel. The weight of this oil-vessel is held by three stout upright wires, outside of the gauze cylinder, and brought together at the top for the reception of the ring by which the whole can be carried. The upper portion of the wire-gauze cylinder is made double to secure greater durability under the corroding effects of the air on the hot wire.

The two Davy lamps first used in a coal mine are still in existence in the collection of the Museum of Practical Geology, London, and are described as of small size, with cylindrical oil-vessels of copper. The wire-gauze envelopes or cylinders are of very fine brass wire, and the mesh is very small. Three iron-wire standards extend from the oil vessel below to a flat brass cap or roof, to which the carrying ring is attached by a swivel joint. The original safety lamp of Sir Humphrey Davy is in the possession of the Royal Institution.

Various modifications of the Davy lamp have been made from time to time, and there is a great variety of lamps in use, but those best known, beside the simple Davy, are the Stephenson, Clanny, Mueseler, and Boty.

Stephenson's safety lamp was invented by the celebrated engineer George Stephenson, at about the same time that Davy designed his. In this lamp the wire-gauze cylinder is lined with a close-fitting glass chimney. The air is admitted below, through a number of small holes in the brass ring. It has a cap of perforated sheet copper. It is considered safer than the common Davy lamp, since the gauze, being kept from contact with the flame by the glass lining, cannot become red hot.

The Miners' safety lamp, invented by Struve, of Swansea, which has been extensively introduced in the fiery collieries of South Wales, is similar to the Davy lamp, differing chiefly in this, that the wire-gauze cylinder is expanded at the bottom and made longer, so as to reach half-way down the sides of the oil box and include half of it. This enlargement of the gauze cylinder at the base gives it a conical form and a much broader surface than at the top. The advantages of the construction are the free admission of air through the numerous meshes of the enlarged base, the greater cooling surface of the gauze, and less obstruction to the diffusion of the light downward and in other directions.

In the Clanny lamp a part of the cylinder of wire gauze is replaced by a cylinder of thick glass, the object being to secure more light from the flame than can pass through the wire gauze in the usual construction. The glass cylinder has a larger diameter than the gauze cylinder, and is supported in a frame made of two brass rings, one above and the other below, and united by six vertical wires. The wire-gauze cylinder is secured to the upper ring, and the air for the supply of the combustion enters through the gauze above the glass, and has to descend to the wick. This construction does not give much more light than a common Davy lamp, owing to the absorption of the light by the thick glass.

Mueseler's safety lamp also has a thick glass cylinder over the light, with a conical gauze chimney above it. It is so constructed that the feed-air is made to descend along the inner surface of the glass, keeping it cool, before being deflected upon the flame. This lamp is much used in the collieries of Belgium and the north of France.

Eloin's lamp has a short, thick glass cylinder around the flame, and the outer surface is curved, so as to diffuse the light. Instead of a wire-gauze chimney, there is a brass tube covered with wire gauze at the top. The air enters through a short vertical wire-gauze cylinder, and is distributed upon the flame by an argand cap.

Boty's lamp also has a short glass cylinder, but above it there is an ordinary gauze chimney. The air is admitted through a perforated copper ring placed a little below the level of the flame.

ILLUMINATING POWER OF SAFETY LAMPS.

All safety lamps differ greatly in their illuminating power, owing to their various forms and the positions of the parts, and to the varied conditions under which the air for the support of the flame is admitted. It is estimated that it requires eight lamps of Davy's construction to give out as much light as a wax candle, six to the pound. Taking such a candle as a standard for comparison, the illuminating power of some of the principal lamps is indicated by the figures which follow, showing the number of lamps required to produce a light in each case equal to one candle.[*]

Davy's lamp, with gauze	8.00
Stephenson's lamp	18.50
Upton and Roberts	24.50
Dr. Clanny's, (glass)	4.25
Mueseler's, (glass)	3.50
Parish's lamp, with gauze	2.75
Davy's lamp, without gauze	2.50
Common miner's candle, 30 to the pound	2.00

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[*] From Hunt's edition of Ure's Dictionary.

In order to prevent miners from opening their lamps, and thus bringing the naked flame in direct contact with the combustible gases, various plans have been devised, the most common being to lock the lamp by means of a screw attached to the body of the lamp, the point of which may be made to enter and hold the brass ring by which the gauze cylinder is held to the oil vessel. This is done by a key which fits the square head of the screw. Lamps are also so made that the light is extinguished as soon as they are unscrewed, and before the body of the lamp and the protecting gauze are completely separated. Dubrulles' self-extinguishing lamp is contrived so that the wick is turned down within the tube as soon as the lamp and the wire-gauze cylinder are disconnected.

LAMP UNLOCKED BY MAGNETISM.

One of the methods recently proposed for so locking the wire-gauze cylinder to the body of the lamp that the miners cannot disconnect the two parts, consists in placing a spring bolt or catch in the interior, without any opening or other means of reaching it from the outside. When the two parts are put together they cannot be separated by mechanical means without cutting into the outer casing. But these spring bolts may be withdrawn by the attraction of a powerful magnet applied to the outside of the lamp.

The efficacy of all safety lamps depends, as is generally known, upon the resistance offered by wire gauze to the passage of flame due to the cooling of the gases. Combustible gases pass freely through the meshes, and may ignite and burn inside of the gauze-cylinder, but ordinarily the temperature of the gauze does not become sufficiently raised to permit the flame to ignite the gas on the outside. Under some conditions, however, the gauze becomes red-hot, and the flame will then pass through.* It has also been found by experiment (September, 1867) that nearly every lamp in use will explode a mixture of carburetted hydrogen gas and atmospheric air, if placed in a current of this mixture.

In these experiments the gas was taken from a 9-inch pipe at the Oaks Colliery, England, where a current of gas flows upward at the rate of three and a quarter miles per hour. An ordinary Davy lamp, with the sheath outside, exploded in 31 seconds, and again in 7 seconds. With the sheath inside it fired the gas in 63 seconds. The Clanny exploded in 13 seconds; a Belgian lamp (Meuseler?) had the glass broken at the end of 55 seconds; several Stephenson lamps gave different results: the flame was extinguished in a few seconds, or continued burning for over a minute. Three of Morrison's lamps were tested, and were extinguished in 7, 5½, and 60 seconds, respectively, the velocity of the current of gas passing at the time being, according to an anemometer, 700 feet per minute.

These experiments, or the reports of them, are very unsatisfactory, inasmuch as the composition of the gas is not stated, nor are details given of the manner in which the lamps were exposed to its action. But similar experiments have been continued, from time to time, and one of the latest reports of them is herewith presented. The results will be seen at a glance by examining the table:†

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* It is the opinion of Robert Hunt, F. R. S., that the hypothesis of cooling will not explain the phenomenon of non-transmission of the flame. He conceives the "impermeability of wire gauze to flame to be due to a repulsive power established between the hot metal and the ignited gas, similar in character, although differing in condition, to that which prevails between water and a white-hot metal."

† From the London Mining Journal, December 4, 1869.

Experiments with mining lamps at Eppleton Colliery, November 25, 1869.

o.	Lamp used.	Velocity of current in feet per second.	Duration of experiment in seconds.	Result.
1	Davy	8	4½	Exploded.
2	Davy	8	3	Exploded.
3	Stephenson's, (original)	8	2	Went out.*
4	Stephenson's S. W. C., (solid tube)	8	9	Wept out.†
5	Stephenson's S. W. C., (perforated)	8	2	Went out.
6	Stephenson's, (original)	8	2	Exploded.‡
7	Stephenson's S. W. C., (perforated)	8	3	Went out.
8	Stephenson's, (original)	8	5	Went out. §
9	Stephenson's, (original)	8	3	Went out.
1	Davy	11. 3	2	Exploded.
2	Stephenson's, (original)	11. 3	10	Went out.
3	Stephenson's S. W. C., (solid)	11. 3	....	Still burning.
4	Stephenson's S. W. C., (perforated)	11. 3	....	Still burning.
5	Stephenson's S. W. C., (perforated)	11. 3	30	Out.
6	Stephenson's S. W. C., (solid)	11. 3	4	Out.
7	Stephenson's S. W. C., (perforated)	11. 3	3	Out.
8	Davy	11. 3	3	Exploded.
9	Stephenson's, (original)	11. 3	5	Out.
0	Stephenson's, (ordinary)	11. 3	5	Out.
1	Stephenson's S. W. C., (solid)	11. 3	6	Out.
2	Stephenson's, (ordinary)	11. 3	8	Exploded.
3	Stephenson's S. W. C., (perforated)	11. 3	10	Out.
4	Stephenson's S. W. C., (solid)	11. 3	30	Out.
5	Davy	11.3	9	Exploded.
6	Stephenson's S. W. C., (perforated)	11. 3	9	Out.
7	Stephenson's S. W. C., (perforated)	11. 3	3	Exploded.‖
8	Stephenson's S. W. C., (perforated)	11. 3	4	Exploded.¶
9	Stephenson's S. W. C., (solid)	11. 3	3	Out.
0	Stephenson's S. W. C., (perforated)	11. 3	5	Out.
1	Davy	14. 3	2	Exploded.
2	Stephenson's S. W. C., (solid)	14. 3	18	Went out.
3	Stephenson's S. W. C., (perforated)	14. 3	7½	Went out.
4	Stephenson's, (original)	14. 3	6	Went out.
5	Stephenson's S. W. C., (solid)	14. 3	36	Went out.
6	Stephenson's, (original)	14. 3	60	Went out.
7	Stephenson's S. W. C., (solid)	14. 3	2	Exploded.**
8	Stephenson's S. W. C., (solid)	14. 3	17	Went out.
9	Stephenson's, (solid)	14. 3	20	Went out.
0	Stephenson's, (solid)	14. 3	60	Went out.
1	Davy	23	1	Exploded.
2	Stephenson's S. W. C., (solid)	23	60	Went out.
3	Stephenson's S. W. C., (perforated)	23	7	Went out.
4	Stephenson's S. W. C., (original)	23	19	Went out.

* This lamp was used in the years 1815 to 1835.
† Made after the same principle as the above lamp.
‡ Exploded through gauze not being in its place.
§ Glass cracked.
‖ This is the lamp left with Mr. Hann on September 30, and which was very much out of order.
¶ Not a distinct explosion—a double report.
** Exploded through a broken glass.

The results of the experiments will be found to correspond very nearly with those tained on September 30 last, (see Mining Journal, Oct. 16,) the Davy lamp having exoded, as before, with a speed of 8 feet per second. It will be seen that only the vy and Stephenson lamps were tried, but the Stephenson lamps tried are divided to four classes:

1. The original Stephenson lamp, which was in use from the year 1815 up to the ar 1835.

2. The improved Stephenson lamp then introduced. This lamp was only improved order to make it more portable, the weight being considerably reduced, and perps a little more light got, but it was not intended to alter the principle of the lamp any respect. It appears, however, that this was done unintentionally to a certain tent, as a close examination of the two lamps, and a careful study of these valuable periments, will clearly show. The original Stephenson lamp tried in the last exriments has a very short copper tube on the top of the glass, and this tube is only rforated at the *top*, and not at the *sides*, while the improved Stephenson has a tube

rather longer than that of the old lamp, and this tube is perforated both at the top and sides; and this slight difference in construction has been shown by these experiments to be of some importance.

3. The Stephenson lamp was tried with a tube not perforated at the sides, thus restoring the lamp very nearly to its present state. And,

4. The lamp which was left with Mr. Hann, described as an ordinary Stephenson, and stated to be very much out of order.

It will be seen that in the first series of experiments shown in the table the speed of the inflammable current was 8 feet per second, and the Davy lamp was readily exploded, but the other lamps were extinguished with one exception when the gauze exploded, "through the gauze not being in its place."

In the second series of experiments a speed of 11.3 feet per second was used, when the Davy, of course, exploded, and the Stephenson lamps stood the test, and, what is remarkable, were not extinguished, but remained burning in some cases. But there is one exception to this, as the lamp described as the ordinary Stephenson (experiments No. 12 and No. 17) exploded, although the other Stephenson stood the test, and the cause of this apparent anomaly appears to be obvious enough.

In the third series of experiments a speed of 14.3 feet per second was used, and the trials varied from 2 up to 60 seconds, the results being that the Stephenson lamps were extinguished with one exception, where "the lamp exploded through a broken glass."

In the fourth series of experiments the speed employed was 23 feet per second, and the three Stephenson lamps experimented upon were simply extinguished. These were the original Stephenson lamp, and the improved lamp, one with a solid tube on the top of the glass, and another with a tube perforated at the sides as well as at the top.

The experiments, on the whole, must be regarded as very satisfactory, as they confirm in every essential particular those formerly made on September 30, and the result ought to inspire the public with confidence as to the safety of the Stephenson lamp under any circumstances likely to occur in mines. The experiments, however, show that great caution and care ought to be used in the construction of those lamps, as a very slight variation in the form may interfere with the principle of the lamp. The copper tube referred to, which is placed on the top of the glass, requires great care, and there is no doubt that it ought only to be perforated at the *top;* and it (the copper tube) ought also to be very carefully fitted to the sides of the wire gauze and the top of the same, so as to prevent any current passing between the glass cylinder and the wire gauze.

From these and other well-known facts, it will be seen that safety lamps, in mines containing explosive gases, afford a relative security only. This was, perhaps, never more strikingly (and harmlessly) shown than in an incident which occurred some years ago, in Zwickau, Saxony.

A lecturer* had been explaining the principle of the safety lamp to a considerable audience, and proposed to illustrate his remarks with an experiment. For this purpose he had prepared a simple apparatus, consisting of a large glass jar and a rubber pipe with a glass elbow at one end. The other end of the pipe was connected with a gas fixture; a safety lamp was set inside the jar, and the bent glass nozzle was introduced to the bottom of the lamp. The lecturer remarked, that, upon turning on the gas, an explosive mixture of carburetted hydrogen and common air would be formed in the jar; the flame of the lamp would be elongated, and a long blue tip would be seen; then the whole interior of the wire-gauze cylinder would be filled with flame; but, though the gauze might become red hot, the flame could not, in any case, strike through to the outside—all of which phenomena, positive and negative, would be clearly visible through the transparent jar. The gas-cock was thereupon opened, but instead of the peaceful demonstration looked for, a prompt contradiction of the theory was the result. The flame was communicated almost instantly to the gas outside of the lamp. In some confusion, the lecturer repeated the experiment, but with the same result; and he finally gave it up, confessing his inability to explain the disappointment, except on the hypothesis of some unknown imperfection in the lamp. The occurrence made a good deal of stir, particularly as there are many coal mines in the Zwickau district troubled with fiery gases, and at that time recent accidents had been occasioned by explosions in spite of safety lamps. The test was therefore repeated, still more publicly, upon some sixty lamps of various patterns, and it was found that only the old-fashioned Davy, and one other, the name of which escapes us, would retain the flame. Those lamps were found to be particularly dangerous which possessed separate openings below for the admission of air to support the flame.

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* Mr. A. Mezger, mining engineer.

These experiments indicate the same conclusion as was lately arrived at by English investigators, namely, that the strength of the draught of inflammable gases through a safety lamp has much to do with the degree of its security. The Zwickau lamp may have been unusually faulty in construction, rather than principle; but this fact, though it might lessen the importance of these special experiments, could not alter the general bearing of both practice and theory on the question of the safety of all lamps. The principle involved is that of the rapid conduction and radiation of heat by the wire of the gauze surrounding the flame. Before the burning gas can pass through the meshes, it is said, so much of its heat will have been abstracted, and radiated away in all directions, that it will fall below the temperature of ignition or explosion. Now, this depends upon the amount of heat communicated to the wire in a given time. The wire may get hot faster than it can grow cool again, and if this increase of temperature is carried to a white heat, the gas outside will be set on fire. But the amount of heat given to the wire in a certain time depends again on the amount of burning gas that passes through it in that time, and hence it is clear that a strong current of gas may overheat the wire and cause an explosion. The Davy lamp is not constructed to favor a strong current. Indeed, one complaint of it has been the feebleness of the light, from insufficient air. It appears, however, that attempts to remedy this deficiency are fraught with peril.

We desire to call the attention of engineers to the great simplicity and conclusiveness of the test above described, and to urge that it be at once applied to the lamps of every mine. There can be no harm in knowing whether the lamps will do what is claimed for them. It is true that common illuminating gas forms with common air a more explosive mixture than does the fire-damp of mines; but the severity of this test ought to be nothing against it, so long as any lamp can be found to bear it.

In the general dissatisfaction with the use of safety lamps, which spread through the Zwickau district after the experiments alluded to, a new and bold plan was suggested, and has been carried out in several cases with the best success. This was nothing more nor less than *to burn naked lights in great numbers* wherever inflammable gases made their appearance. Some of the workings presented, under this system, an unwonted appearance. In one case, the fire-damp could be heard streaming out of the fissures of the coal, with that peculiar humming sound which the miners know so well and fear so greatly; the innumerable lights carried each a long blue tip—the usual signal of danger—yet no harm occurred. The gases were quietly consumed as fast as they entered the mine, and the illumination was carefully kept up, night and day, Sundays and between shifts, that no opportunity was given for an accumulation of explosive material.

The great difficulty of this plan is its direct injurious effect on ventilation. The stationary lights with which the mine is crowded, in addition to those carried by the workmen themselves, must necessarily use up a good deal of oxygen, and produce a good deal of carbonic acid. But this is an evil which can be combated in other ways and, at all events, it is preferable to the danger of explosion. Perhaps it might be an improvement to use safety lamps instead of naked lights, hanging them in great numbers along the walls, so as to secure the complete, quiet combustion of the gas. But it must be confessed that, even under circumstances of the greatest danger, the naked lights have done very well, and no accident, so far as we are aware, has ever resulted from their use in this way.

Propositions have been made to explode the accumulated gas in workings before the workmen are allowed to enter it. In a rude way, this has frequently been done in fiery mines; and to remove all personal danger, it is now suggested that the explosion be effected by means of a battery. But this whole system of allowing the fire-damp to accumulate while the workmen are absent, and then firing it off all at once, strikes us as much inferior to the simple expedient of burning it gradually, as above described.

FIRES IN MINES, AND THE MEANS OF EXTINGUISHING THEM.

In spite of all precautions in the way of proper ventilation and the careful use of safety lamps, fires will sometimes occur, as many mining communities have had terrible opportunities of knowing. The methods employed for extinguishing them are therefore worthy of notice. On this subject I cannot do better than quote the excellent essay of Mr. R. P. Rothwell, of Wilkesbarre, Pennsylvania, which appeared last summer in the New York Engineering and Mining Journal:

> Taking account of the nature of the mineral, we are not surprised that fires should be much more frequent and dangerous in coal than in ore mines; they are, however, by no means confined to coal or lignite deposits, but may and do occur in all kinds of underground workings where timber is used. In the great majority of cases fires originate, below as above ground, through carelessness or imprudence. A miner will lean his lighted candle or lamp in such a position that it can ignite a prop or other piece of timber. Such appears to have been the case in the recent disastrous fire in the Crown Point, Kentuck, and Yellow Jacket mines. The careless or imprudent hanging of a grate or fire-pot near the coal at the foot of our downcast shafts or slopes (where it is placed in winter to prevent the pumps and rods from being covered with ice) has been the cause of fires in several of our anthracite mines. Ignorance of, or inattention to, the proper manner of constructing ventilating furnaces has also been a frequent cause of fires in coal mines, but probably the most fruitful cause of these disasters is the ignition of fire-damp, or carbureted hydrogen in coal mines; the ignition first produces explosion, and in mines yielding an inflammable coal it frequently ignites the fine particles blown about in a burning atmosphere, and these communicate the fire to the solid coal of the pillars; or the gas may continue to burn at some "blower" till it has ignited the coal in which the fissure or vent occurs. These so-called "accidents" are generally due to carelessness in the use of "open" lights, or in the opening of safety lamps in places where the gas exists in quantity. The practice of blasting in coal mines, which produces large quantities of the dangerous gas, has also caused a great number of deplorable explosions and fires; and the question of substituting some other agent, such as water, wedges, &c., for powder in mines of this kind, is now receiving much attention among European mining engineers. "Fiery" mines, such as those in the Richmond (Virginia) bituminous basin, would be greatly benefited by the successful substitution of a safer agent for the powder now used, where rock or hard coal has to be mined. In our anthracite mines the hardness of the coal would render the use of powder more necessary, while the smaller quantity of fire-damp found in it would, at the same time, make the substitution of a safer agent less desirable. The exercise of greater vigilance in the inspection and use of safety lamps would, doubtless, greatly diminish the number of explosions and fires in coal mines.
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> Many bituminous coals, and bituminous shales which are found among the coal beds, are, under certain circumstances, subject to "spontaneous combustion." This always occurs where the coal or shale is crushed in a confined space with an exceedingly feeble ventilation; indeed, spontaneous heating of the coal, accompanied as it is by an abundant production of carbonic-acid gas, was generally attributed to the decomposition of iron pyrites (sulphuret of iron) under the influence of the moisture in the air, and a circulation of air so languid as not to dissipate the heat generated, while sufficient to

supply the oxygen necessary to support combustion. It has, however, been observed that the coals producing the greatest quantity of pyrites are not always the most subject to heat spontaneously, while it has also been noticed that the most inflammable coals are those containing the largest proportions of oxygen; it has, consequently, been suggested that the more probable cause of spontaneous combustion may be the combination of oxygen with the carbon, under the influence of moisture, and which is accompanied by the generation of carbonic acid and a considerable amount of heat. In the coal mines of Silesia, where cases of spontaneous combustion are of frequent occurrence, numerous observations have demonstrated that this class of accidents need not be feared where the "roof" of the vein is either sandstone or conglomerate, nor near the outcrop, whatever the nature of the top rock may be; on the other hand, beds worked at a considerable depth, or even when moderately near the surface, but covered by a shale capable of being softened by moisture, are the most liable to spontaneous combustion.

It was long considered in Silesia that the only means of preventing fires from this cause, consisted in sending all the fine coal, "waste," or "gob," out to the surface. This was often impracticable, expensive, and not always effectual; hence other means of attaining the same end were sought for. Since it is well known that combustion cannot exist when deprived of oxygen or air, one means of preventing spontaneous combustion consisted in isolating the working places, or goaf, by means of a heavy dry wall, or by two parallel walls filled in between with clay or other material packed hard, and sometimes a heavy pillar of coal was left for the same purpose. In each case, however, the weight of the superincumbent rocks almost invariably crushes the walls or pillars, and produces cracks or fissures, through which air, sufficient to sustain the slow combustion of the coal, can pass. This method has been employed with greater or less success in some of the mines in the centre of France, and in the thick seam of Staffordshire. It is evident that when used the greatest possible care must be taken to keep the fissures closed, which are found from time to time, so as to seal hermetically the space inclosed. But besides the practical difficulty in effecting this, the fact that these inclosed spaces generally fill with fire-damp, and therefore form veritable magazines of a substance far more dangerous than powder, and which, through the crushing of a wall or pillar, or the fall of a portion of the roof, may at any moment be brought in contact with the lights of the men working in fancied security in the neighboring roads or chambers, is a sufficient reason for condemning so dangerous a system as that of isolation of the "goaves" by "pack walls."

The spontaneous heating of coal is so slow a process that the increment of temperature is easily carried off by a moderately rapid current of air; we can thus prevent the temperature from ever rising to the point of ignition, by simply ventilating the "goaves;" this, then, is the exact opposite of the last method, and though much safer and fully as practical, yet very serious objections can be made to it. It is all but impossible, owing to falls, &c., to keep the "goaves" sufficiently open to maintain the necessary circulation of air, and the expense of clearing up falls and opening the old workings, where obstructed, is so great as to render this method impracticable in many cases. The system is, however, more or less successfully used in many mining districts in England, Silesia, &c. There now remains but one other method to describe, and it is by far the safest and most efficient in the prevention of danger by spontaneous combustion. It consists in filling or packing with earth and other material sent down from the surface the spaces from which the coal has been removed, and which the waste of the mine does not fill. This method, though somewhat expensive in large seams which make but little waste, is assuredly the most effectual remedy, since it not only prevents the admission of air to the old workings, and therefore does away with the expense of ventilating them, but it prevents the falls of the roof, in which "blowers" are frequently opened, and renders impossible any accumulation of fire-damp, which is the great source of danger in the method of isolation by pack-walls, &c. Thus this method not only procures perfect immunity from danger by spontaneous combustion, but the system of mining of which it is the principal feature enables us to obtain all the coal of the vein. It is, therefore, not only the safest, but also, as regards the amount of coal obtained, the most economical, method now in use, and it is deservedly popular in Europe, and more especially in France, Belgium, and Germany, where it has been employed for a number of years, and has now taken the place of every other system in most of the coal mines.

Whatever precautions may have been taken to prevent fires, yet the carelessness, ignorance, and sometimes the malice of men are causes which cannot always be effectually guarded against; hence we must be prepared to meet the danger of fire when it occurs, and to apply *promptly* the most suitable means for its extinction.

When a fire originates in coal or timber, every effort should be *immediately* made to extinguish it by throwing water on it either with buckets, or, better, with a fire engine; or where practicable, by tapping the column-pipe of the pump and leading the water through hose to the seat of the conflagration. In some cases the use of portable "fire extinguishers," (which generate carbonic acid gas,) such as are now found in every village of the land, may prove of great service. If the fire originates by the ignition of a blower of fire-damp, efforts should be made with wet cloth, water, &c., to put out the flame; in some cases where these means failed, the flame has been extinguished by the concussion of the air, caused by discharging a cannon in the gallery where the fire exists. When the coal surrounding the "blower" has already become ignited it will immediately re-ignite the fire-damp; so that this method can only be applied either where the blower is in rock or where it has not had time to thoroughly ignite the coal. While these means are being applied, preparation should be made for erecting stoppings or dams, in view of the failure to extinguish the fire by the direct means; yet these should not be abandoned till there is no further possibility of success. When it is no longer possible to approach the fire near enough to throw water on it—that is, when the fire can no longer be kept under control—it becomes necessary to resort to other methods of extinction, viz:

By isolating the part of the mine on fire, and then applying extinguishing agents to the part inclosed. When this fails or becomes impracticable, there remains but one other method, viz:

. By closing the entire mine, and applying the same extinguishing agents.

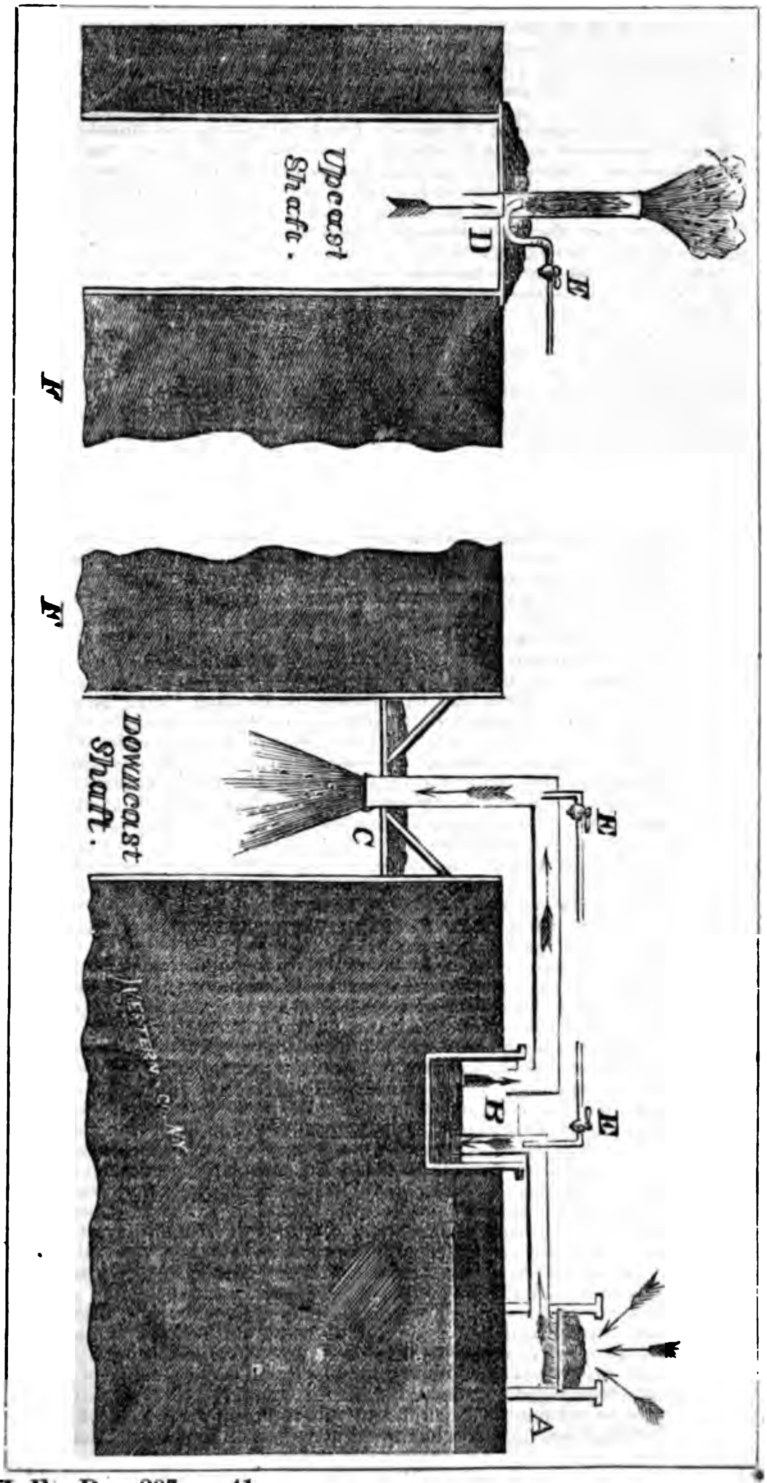
These agents are water, carbonic acid, and nitrogen gases, steam, or any other gas incapable of sustaining combustion; those mentioned being adopted on account of their effectiveness and small cost.

The isolation of a fire in a mine is effected by constructing walls or stoppings across all the galleries or other openings which connect this portion with the remainder of the mine. These stoppings are sometimes walls of brick or masonry, varying in thickness from twelve inches to six or eight feet; at other times two lighter parallel walls are built, and a current of air allowed to circulate between them in order to keep the inner wall cool, or else the space between the walls is filled in with clay and mine-waste; while still another method is to make a stopping, several yards in thickness, entirely of clay, waste, &c. In cases where it can be done without danger, a timber stopping or even a simple board bratticing can be adopted; the kind of stopping as well as its strength will depend on the position of the fire, its extent, the presence or absence of fire-damp, whether the stopping is intended to dam back water or not, and such like considerations, which under the ennunciations of fixed dimension, are impracticable. The *essential* in every case is that the stopping should be *air-tight*, and that it should be constructed with the least possible delay, and at such a distance from the fire as to allow time for its completion, before the smoke and irrespirable gases produced by the fire can prevent the men from working.

Notwithstanding that the ventilation of the part on fire has been reduced to a minimum by the erection of temporary bratticing, &c., yet the combustion of the coal and wood produces such enormous volumes of irrespirable gases that the work of building the stoppings is one of great difficulty and danger, more particularly in mines producing fire-damp, where the danger from explosion is still greater than that from the gaseous products of combustion.

It is evident that the stoppings can be constructed with least difficulty by commencing with those on the "outside" of the fire, or the side from which the air *proceeds to* the fire, and afterward building those "inside" the fire, or where the air *comes from* the fire; yet in mines yielding fire-damp this method of proceeding is attended with great danger; the fire-damp mixing with the air confined between the stopping and the fire makes an explosive compound, which is carried forward toward the fire, where it ignites, and though it may not cause a fatal accident, yet it almost invariably throws down the stoppings by which it was sought to isolate the fires. As from one-tenth to one-seventh of its volume of carbonic acid, added to an explosive mixture of air and fire-damp, renders the latter entirely inexplosive,(a larger quantity renders it incapable of sustaining combustion,) and as the products of combustion are carbonic acid and nitrogen, it follows that by closing first the galleries on the side toward which the air from the fire goes, we prevent the danger of explosion by mixing carbonic acid with the air contained between the stopping and the fire, and by throwing the smoke and irrespirable gases back on the fire, we go far toward extinguishing it. It is true it is a matter of great danger and difficulty to build stoppings between a fire and the "returns," but by the use of temporary bratticing and by commencing at a sufficient distance from the fire, it is often practicable, and it is always desirable. Where it is impossible to build the stoppings in this order then, when practicable, it would be advantageous to inject carbonic acid gas, or choke-damp, (through a pipe in the stopping,) from the moment the latter comes near completion, so that the air contained between the stopping and the fire may not become explosive. We speak, of course, of mines yielding fire-damp. Where carbonic acid is not available, it will sometimes be possible to inject steam, which will not only deaden the fire, but will, at least, diminish the intensity of the explosions.

The stoppings completed—and where there is no danger from explosion or need of inundating with water the part on fire, there is no necessity for making them heavy—we proceed to fill the part inclosed with carbonic acid gas, with choke-damp, with steam, or with water. In the first case the carbonic acid can be manufactured either



Goldsworthy Gurney's apparatus for manufacturing After-damp, 1849.

A.—Furnace. B.—Water-tank. C.—Downcast stopping. D.—Upcast stopping. E, E, E.—Three steam jets. F, F.—Galleries from shaft to shaft.

pure, or nearly so, by the use of any strong acid, such as sulphuric or muriatic acid and chalk, or limestone, or any of the carbonates of low price and easily decomposed. This gas is easiest prepared in a lead vessel, which is not attacked by the acid. Where the space to be filled is not great, some of the numerous patent fire-extinguishers might be found of service, as being quickly and easily brought into action. These methods have the advantage of supplying the gas at a low temperature, and thereby facilitating the cooling of the rocks after the flame is extinguished. If the circumstances are such as to make the use of choke-damp—that is, a mixture of carbonic acid and nitrogen—advisable. it can be produced in one of the furnaces of which drawings and particulars are given below. In either case, as carbonic acid and choke-damp are both heavier than air, it follows that the tube through which we admit these gases should be at the lowest, and that through which the air from the inclosed space is allowed exit should be at the highest attainable point of the isolated workings, and the admission of the gases should be continued till it is evident they have completely filled these works. This is easily proved by their instantly extinguishing lamps, burning tow, &c., at the outlet tube. The tubes should then be closed, leaving only a siphon or water-gauge to mark the difference in pressure between the inside and outside of the stoppings, and a place for the introduction of a thermometer used to note the variations in temperature, so as to know when it will be safe to open the stoppings. The greatest care should be taken to keep the stoppings air-tight; they should be frequently inspected, and where from any reason it is found desirable to "drown out" or inundate the part on fire, they should have a thickness proportionate to the head of water they will have to retain.

When the fire has assumed greater dimensions, or when its position is such that it becomes dangerous or impossible to confine it by stoppings such as we have described, it becomes necessary to abandon the entire mine and to resort to closing the shafts.

Even when it is decided to inundate the mine, it is always advisable to close the pit, whether the mine produce carburetted hydrogen (fire-damp) or not, since by so doing we deaden, at least, the combustion, and prevent, in a great measure, the damage always caused by the high temperature produced by a rapid combustion. The shaft should, therefore, be immediately closed hermetically, provision being made for openings through which a registering thermometer can be introduced, and a bent pipe, or siphon, containing water, to show the pressure behind the stopping, and prevent its becoming excessive, while at the same time it prevents the admission of fresh air.

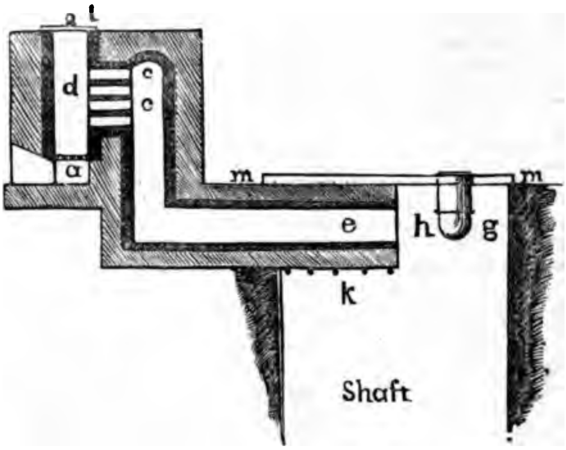
The closing of the shaft may be effected by hanging heavy pieces of timber, by means of chains, some distance down the shaft. On the platform thus made clay is thrown, and packs itself by the force of the fall, thus rendering the stopping perfectly air-tight. The tubes above mentioned should be inserted, and one siphon should be so arranged as to allow the water to flow down the shaft, instead of accumulating above the stopping. Where the pit is divided into a number of compartments, it becomes difficult to close it perfectly in this way. The mouth of the pit is then covered over with planks or iron doors, and clay, sand, &c., packed on this, every crevice being carefully closed. Great attention must be paid to this, more particularly in the case where it is desired to "smother out" the fire without the injection of steam or carbonic acid, otherwise a quantity of air may enter, which, though insufficient to maintain an active combustion, may yet suffice to support a slow fire, or, at least, greatly increase the time necessary for its complete extinction.

Where the mine does not produce fire-damp, there is no great danger in closing the pit, but if that gas is given off in any considerable quantity, the closing of the pit is sometimes attended with great danger, there being a certain time after the closing when the quantity of atmospheric air is sufficient to make an explosive mixture with the gas from the mine. After a time, the quantity of air, or rather oxygen, is diminished by that consumed by the fire itself, and the incombustible gases produced by the combustion, mixing with the fire and fire-damp, soon render the compound inexplosive. In such mines it is highly desirable to inject steam alone, or, better, steam and carbonic acid, into the downcast from the earliest practicable moment, so as thereby to diminish, as far as possible, the chance of explosion during the operation of closing: and it should continue to be injected after the stopping is made till the mine is completely filled, which can be known by the air issuing from the upcast extinguishing a lighted lamp, &c. It is almost needless to add, that great care should be taken, and no open lights allowed near the shaft when there is any possibility of fire-damp existing in dangerous quantity. If the mine does not produce that gas, the immediate admission of choke damp is not so necessary, though it is always desirable as checking the spreading of the fire.

As the majority of fires occur from explosions of fire-damp, it follows that in most cases the air doors, bratticing, and other divisions necessary to guide the air current through the mine, are destroyed. It is then difficult to ascertain if the carbonic acid has gone into every part of the mine, or whether a large amount of air may not yet remain in the workings; this should be carefully considered in deciding on the means to be adopted to extinguish the fire, and also in fixing on the time for reopening the pit. Not a few of our fatal accidents occurring from explosions were caused by reopening the mine too soon, or before the coal had time to cool down below the temperature at which it will ignite. In some cases, it may even be considered safest and most economical to fill the mine with water. This decision must be taken only after a careful consideration of the position of the fire, the amount of water needed to fill the works to the depth required, the time necessary to pump in that water, the nature of the roof and coal in the works, and the effect which a longer or shorter inundation would have on them, the facility for getting the water out, &c. The inundation of a mine is always an expensive expedient, and should only be adopted as a last resort; yet there are cases where it is undoubtedly the best method to adopt. Each case requires a special study, and the method which might be the most suitable in one may not be adapted to another. The great sources of expense in inundating a mine are the damage caused by the water remaining for any length of time in the works (with certain kinds of rocks—some slates and fire-clays especially,) the falls of roof, causing delay and expense, and the delay and cost of filling with and pumping out the water. And in coal subject to spontaneous combustion it not unfrequently happens that when the water has been pumped out, the wetting of the "gob," or "waste," causes it to heat, and even to ignite, before the ventilation can be fully re-established. Every other means should in general be tried before inundating the mine, and the most efficient of these various means are the introduction of steam, carbonic acid, (choke-damp,) and after-damp, which is a mixture of nitrogen and carbonic acid. Steam is available at almost every mine, and is easily applied; it should be carried in pipes, and discharged as near the seat of the fire as possible, in order to prevent its condensation; it is a very efficient extinguishing agent, and from the facility with which it can be employed, it is now commencing to be much used; in many cases, a rubber hose, made especially for a steam hose, is all that is required to carry it for several hundred feet, and it will last as long as the occasion requires in most cases. The greatest disadvantage in the use of steam is its energetic action on some rocks, causing them to disintegrate and "fall;" but where the roof is such that it is not materially injured by steam, this is one of the most convenient, and it is always one of the most effective extinguishing agents we can use. Its action is limited to the expulsion of the air, and as it maintains a high temperature we are generally obliged to inject water, in order to cool the rocks sufficiently to allow the men to work, and also to prevent any possibility of reignition. The following example of its application will prove instructive: In 1857, at the St. Mathew mine, near St. Etienne, France, steam was injected after the mine had been on fire for eight days; this was continued for seventy hours, after which cold water was injected for three days, in order to cool the sides of the shaft, galleries, &c., previous to descending into the mine. The pit was then opened, and a current of air circulated while the men went down. After two days, however, the mine again caught fire, and it became again necessary to close the pit. Steam was then injected during twenty-four hours, and, after an intermission of eighteen hours, cold water was injected for twelve hours. The fire broke out a third time, and steam was admitted for eleven hours, then cold water, after which the men were enabled to enter, and extinguish the fire completely by throwing water on it. I believe the same process was employed at the Yellow Jacket and Kentuck mines, on the Comstock lode, which were on fire a few months ago.

The application of carbonic acid or choke-damp and after-damp is more complicated than that of steam, since the materials for its manufacture are not often on hand. The most usual method of manufacturing carbonic acid is by means of chalk or limestone, or any cheap carbonate easily decomposed, treated with one of the cheaper acids—as sulphuric, nitric, or hydrochloric. The gas produced in this way has the advantage of possessing a low temperature; it not only extinguishes the fire but tends to cool the rocks to a point below the temperature necessary for ignition. Portable machines, known as "fire extinguishers," are convenient means of manufacturing this gas where the quantity required is not very great, and they are to be found everywhere, at a small cost, and are always ready for use. Where the quantity of gas required is very large, as, for example, in filling a mine, one of the cheapest and most convenient methods of producing it is by the combustion of coke or charcoal in a furnace of suitable form, and, as it was the means adopted in the first application of "after-damp" or carbonic acid to the extinguishing of fires in mines, we will devote some space to it, especially as the credit of the invention is commonly misapplied. The first application was made by M. Jules Letoret, in Belgium, in the year 1844. Five years later (1849) we find the same principle applied in England by Goldsworthy Gurney, who takes credit himself for the invention, and is even at the present time credited with it by nearly all the English engineers. It is scarcely possible that Mr. Gurney could have been ignorant of M. Letoret's invention, for we find him perfectly "posted" on the application of his steam jet in the Belgian mines, about the same time.

On the 15th of February, 1844, a fire occurred from an explosion of fire-damp in the No. 2 shaft, Agrappe colliery, near Mons, in Belgium; the pit was 1,171 feet deep, three veins at different levels being worked. Efforts were made to extinguish the fire by throwing water on it; but it had already made too great progress, the frequent explosions of fire-damp having become very dangerous. It was then decided to reverse the ventilating current in order to prevent the fire from destroying the pumps. M. Jules Letoret then prepared to introduce carbonic acid into the works, that gas having, as we have already stated, the property of rendering harmless an explosive mixture of carbureted hydrogen and air, if only added to it in the proportion of one-tenth to one-seventh. Several experiments were made for the manufacture and introduction of this gas—the first on the 17th of February, 1844. The effect of the gas was to reduce the number and violence of the explosions, but the fire still continued to burn at the foot of the shaft; the pit was not perfectly closed at the time. On the 23d of February M. Letoret built a furnace, intended to produce carbonic acid, in a continuous manner, from the combustion of coke; the shaft was closed hermetically, leaving only openings for the introduction and outlet of the products of combustion. This apparatus is shown in the accompanying figure, and is of so simple a construction as to require but little explanation. The furnace was charged with burning coke and charcoal to the depth of 17 inches, that depth being found sufficient to consume all the oxygen in the air passing through the fire, and to produce carbonic acid and nitrogen, (a greater depth of fire will produce at the same time carbonic oxide;) and as this gas issued from the furnace at a high temperature the reservoir of water, *h*, was inserted through the stopping, so that the gases might be cooled and prevent any chance of igniting the woodwork of the shaft. When the apparatus was set to work on the 24th of February, the fire was visible at the foot of the shaft; on the 25th the flames and explosions had ceased; the introduction of "after-damp" was then stopped, and fresh air was allowed to enter the mine; but on descending into the mine a large fire was discovered, quite red, but with little flame. The work of clearing out the gallery leading to it was commenced, in order to be able to throw water on the fire; but the barometer indicating a diminishing atmospheric pressure, the fear of fresh discharges of carbureted hydrogen induced the abandonment of the mine, into which carbonic acid was again introduced. On the 26th, the flame and explosions having again ceased, fresh air was readmitted, and on entering the mine water was thrown on the fire by means of fire-engines; timbers were set, though with difficulty, on account of the high temperature, and because the rocks, decomposed by heat, disintegrated and fell when water was applied. This work was continued to the 3d of March, when the fire was entirely extinguished and the rocks cooled down. The roof had fallen to the depth of 22 feet. Thus a fire which had threatened to destroy the mine, or at least to prevent its working for months or years, was completely extinguished in the course of ten days.



Letoret's Furnace for manufacturing After-damp, 1844.

a.—Ash-pit. *d.*—Fire-place. *c.*—Pipes carrying off the flame. *e.*—Pipe carrying gas into the pit *f.* *g.*—Pipe admitting water. *k.*—Iron bars supporting *e.* *m.*—Iron flooring covered with soil.

The above particulars, taken from a "Memoire" by M. Jottrand, in the "Annales des Travaux Publiques de Belgique," though very brief, are yet sufficient to show the manner of operating in such cases, and to establish M. Letoret's claim of invention of this method of extinguishing fires in mines.

I shall now describe Mr. Gurney's furnace and manner of operating. The full particulars are given in a parliamentary report on accidents in coal mines, 1849.

The drawing on page 641 shows the arrangement of the apparatus. The furnace was four feet square, the ash-pit air-tight, and the pipe leading from it thirteen inches in diameter. This pipe plunged into a tank of water, B. In order to cool the gas before entering the mine the air was drawn through the fire and forced into the pit by means of three steam jets, E E E, working with a pressure of from thirty to forty pounds of steam in the boilers.

The fire which called this apparatus into use occurred in the Astley pit, (390 feet deep,) near Manchester, England, on the 2d April, 1849. The mine being very fiery, there were great fears of an explosion. The engineer in charge, Mr. Darlington, wrote to Mr. Gurney—well known from his application of the steam jet to mine ventilation—to know if there was any means of "drawing fire-damp out of a closed mine without letting air in." Mr. Gurney, in his evidence before the parliamentary committee above referred to, says: "An idea struck me, (from experiments I had made in passing air through a closed vessel running through the fire, where I found the whole of the oxygen to be combined, and nothing going out but nitrogen and carbonic acid,) if we made a large furnace and connected with the ash-pit, perfectly air tight, a cylinder, and put a steam jet in the cylinder, we might draw air through the fire and drive nitrogen into the mine." Mr. Gurney found that passing air through a fire 18 inches deep would consume the whole of the oxygen of the air; M. Letoret found 17 inches sufficient. It is evidently desirable that the depth of the fire should not much exceed that necessary to effect the complete combustion of the oxygen and the formation of carbonic acid; for when it is increased a portion of the carbonic acid takes up another equivalent of carbon and forms carbonic oxide, a gas which, though incapable of sustaining combustion, being itself combustible, would not act as energetically as the carbonic acid or nitrogen in preventing explosion or combustion.

After injecting this after-damp (mixture of about four-fifths nitrogen and one-fifth carbonic acid) into the pit for two hours, a little white cloud coming out of the upcast showed that the mine was full, which fact was easily proved by the gas coming out of the pit extinguishing burning tow, &c. The quantity of gas injected was estimated at 6,000 cubic feet per minute, and the operation was continued for five or six hours after the gas commenced to come out of the upcast. The fire was then drawn and fresh air forced through the mine by the same pits. After two hours and twenty minutes the cloudy appearance at the upcast disappeared, and a lamp would burn in the gas coming out. The fire was found to be extinguished, though it had been burning for nearly two weeks before commencing this operation. The expense of the apparatus was estimated not to exceed five to ten pounds.

In a fire which occurred about two months later (June, 1849) in the same pit, Mr. Darlington applied carbonic acid made in the wet way—with limestone and sulphuric acid. The fire in this case was walled off and the generating apparatus placed in the lower gallery, and a quarter-inch steam jet placed in a pipe inserted through the stopping in a higher gallery. Mr. Darlington says: "We commenced injecting carbonic acid through the four-inch pipe at 2 a. m., and at 5 a. m. the men were at work." Of course the fire was a fresh one, or the rocks would not have had time to cool in that time. The expense was from £10 to £15, or more than that for filling the entire mine with after-damp in the previous case, where the gas was made with "charcoal, the waste coal round the pits, and a little limestone."

SECTION IV.—BREAKING, CRUSHING, AND GRINDING ORES.

CHAPTER LXXVIII.

BREAKING AND CRUSHING.

Ores which reach the surface in large solid blocks require to be broken into fragments that can be easily handled before they can be placed in machines for reducing them to still smaller fragments, or to powder.

The sledge is the simplest and most common tool for this purpose; and it is followed by spalling hammers, until none of the fragments are much larger than the fist. Until within a few years this was the common and only way of breaking up ore into sizes suitable to be fed into the mortars of stamp-batteries, and it is still used where only small quantities are to be broken, and the extent of the operations do not justify the expense of obtaining suitable machines for the purpose.

HEAVY STAMPS.

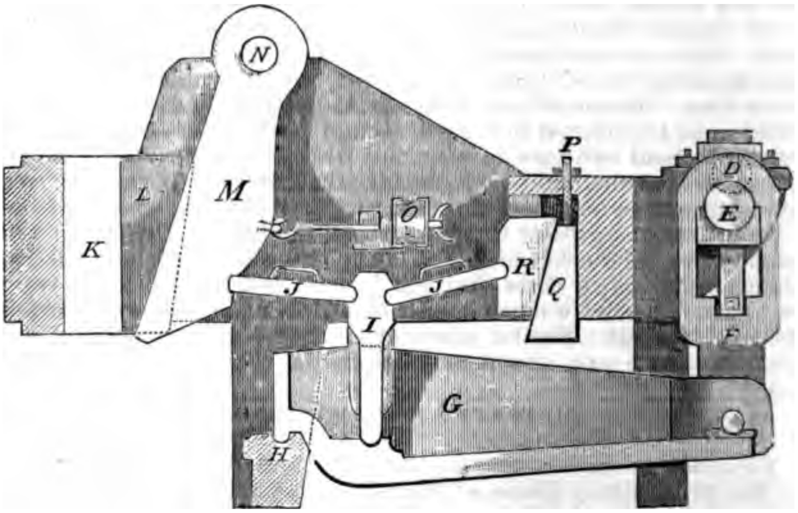
The first attempts upon the Pacific coast to substitute machine for hand labor in spalling ore were in the direction of stamps of unusual weight, raised by cams to a height of four feet, and allowed to drop upon the mass of rock to be broken. Stamps of this kind, either single or two in a battery, were placed at the superb mills erected near Aurora, at the Real del Monte, and at the Antelope. They weighed 2,000 pounds each. There were no mortars, but a solid bed or anvil was surrounded with massive grates, made of bar iron, through which the fragments could drop. Masses of ore, from one to two feet in diameter, could be rolled in and subjected to a succession of blows. The two heads could break up about two tons an hour, but with an enormous expenditure of power, as is evident when we consider that for each blow a ton weight of stamp was to be raised four feet, and also that the smaller the mass to be broken the greater was the force of the blow. Thus when a mass of quartz, say six inches in height, lay upon the anvil, the stamp fell upon it from a height of three feet six inches; but when a block two feet high, which needed a much harder blow, was upon the anvil, the stamp fell only two feet. Similar stamps were in use at Washoe and at Virginia, but were soon abandoned because of their manifest defects and cost.

BLAKE'S ROCK BREAKER.

The machine for breaking up rock now most in use is the invention of Mr. Eli Whitney Blake, of New Haven, Connecticut, and is generally known as Blake's Rock Breaker. It was designed at first to break up trap-rock into fragments for macadamizing roads. Its value for breaking ores into sizes suitable for feeding to stamps or jigs was quickly seen, and in 1861 it was introduced into California. Its first operation in the mines was at the Benton Mills upon the Merced River. The ore delivered there from the Pine-tree vein is noted for its hardness and massive character, and it required the constant labor of thirty Chinamen to spall enough to keep the stamps supplied. The same and a greater amount of work was better performed by the machine in a few hours, and effected a saving of seventy-five dollars a day, when sufficient rock was furnished to keep the machine running. From that time it has been extensively used, and is recognized as an indispensable adjunct to every well-appointed stamp mill.

The general construction of this machine has been rendered familiar by numerous figures and publications in the United States and in Europe. It consists, essentially, of a strong iron frame, supporting upright convergent iron jaws, actuated by a revolving shaft. The stones or masses of ore to be broken are dropped between these jaws, and a short reciprocating or vibratory motion being given to one or both of them, the stones are crushed, and drop lower and lower in the converging or wedge-shaped space, until they are sufficiently broken to drop out at the bottom. The size of the broken fragments may be regulated by increasing or diminishing the size of this opening between the jaws. But the construction and operation of the machine will be made more clear by the inspection of the annexed figure, accompanied by a description in detail of the various parts.

This figure is a sectional side view or elevation of the machine, representing the parts in place as they would be presented to view by removing one side of the frame. The parts of this figure which are shaded by diagonal lines are sections of those parts of the frame which connect its two sides, and which are supposed to be cut asunder in order to remove one side and present the other parts to view. The dotted circle D is a section of the fly-wheel shaft; and the circle E is a section of the crank. F is a pitman or connecting rod, which connects the crank with the lever G. This lever has its fulcrum on the frame at H. A vertical piece, I, stands upon the lever, against the top of which piece the toggles J J have their bearings, forming an elbow or toggle-joint. K is the fixed jaw against which the stones are crushed.



Blake's Rock Breaker—section.

This is bedded in zinc against the end of the frame, and held back to its place by cheeks, L, that fit in recesses in the interior of the frame on each side. M is the movable jaw. This is supported by the round bar of iron N, which passes freely through it and forms the pivot upon which it vibrates. O is a spring of India-rubber, which is compressed by the forward movement of the jaw and aids its return.

Every revolution of the crank causes the lower end of the movable jaw to advance toward the fixed jaw about one-fourth of an inch and return. Hence, if a stone be dropped in between the convergent faces of the jaws, it will be broken by the next succeeding bite; the resulting fragments will then fall lower down and be broken again, and so on until they are made small enough to pass out at the bottom. The readiness with which the hardest stones yield at once to the influence of this gentle and quiet movement, and break down into small fragments, surprises and astonishes every one who witnesses the operation of the machine.

It will be seen that the distance between the jaws at the bottom limits the size of the fragments. This distance, and consequently the size of the fragments, may be regulated at pleasure. A variation to the extent of five-eighths of an inch may be made by turning the screw-nut P, which raises or lowers the wedge Q, and moves the toggle-block R forward or back. Further variations may be made by substituting for the toggles J J, or either of them, others that are longer or shorter; extra toggles of different lengths being furnished for this purpose.

Machines are made of various sizes. Each size will break any stone, one end of which can be entered into the opening between the jaws at the top. The size of the machine is designated by the size of this opening; thus, if the width of the jaws be 15 inches, and the distance between them at the top 9 inches, the size is called 15 by 9.

The product of these machines per hour, in cubic yards of fragments, will vary considerably with the character of the stone broken. Stone that is brittle, like quartz, granite, and most kinds of sandstone, will pass through more rapidly than that which is more tough. The kind of stone being the same, the product per hour will be in proportion to the width of the jaws, the distance between them at the *bottom*, and the speed. The proper speed is about 180 revolutions per minute; and to make good road metal from hard, compact stone, or to prepare ores for stamps, the jaws should be set from 1¼ to 1½ inches apart at the bottom. For softer and for granular stones they may be set wider.

The following table shows the several sizes of machines commonly made, the product per hour of broken stuff from the hardest materials, when run with a speed of 180; the power required to perform this duty; the whole weight of each size in round numbers, and the weight of the heaviest piece when separated for transportation.

Size.	Product per hour.	Power required.	Total weight.	Weight of frame and parts attached.
10 by 5	4 cubic yards.	6 horse.	6,600 pounds.	3,200 pounds.
10 by 7	4 cubic yards.	6 horse.	7,600 pounds.	4,100 pounds.
15 by 5	6 cubic yards.	9 horse.	9,100 pounds.	4,700 pounds.
15 by 7	6 cubic yards.	9 horse.	10,200 pounds.	5,600 pounds.
15 by 9	6 cubic yards.	9 horse.	11,600 pounds.	6,800 pounds.

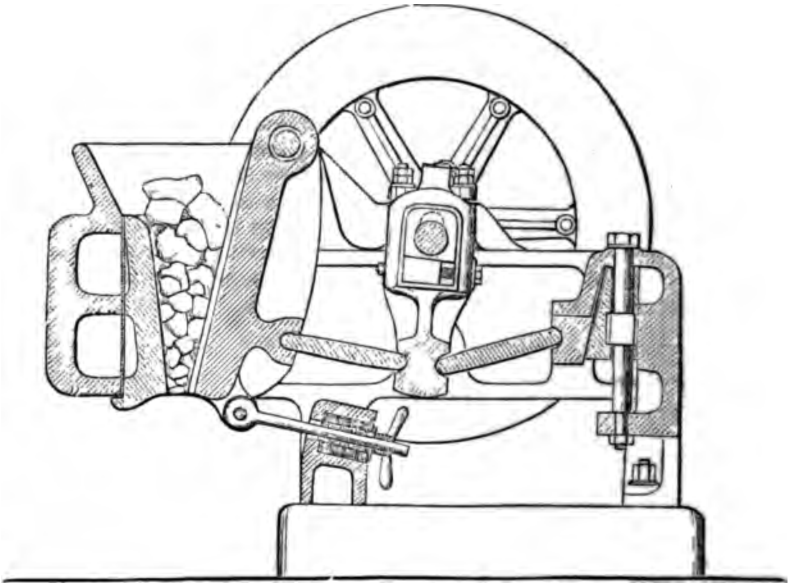
The whole length of the machines to the back-side of the fly-wheels is from 8 to 8½ feet; height to top of fly-wheels, 5 feet; width, from 4 to 5 feet.

The machine may be driven by any power less than that given in the table, yielding a product per hour smaller in the same proportion.

Either of the sizes mentioned will break quartz enough in a few hours to feed a forty-stamp mill for one day. A machine of less capacity would of course have a smaller mouth and would not take large stones. It is usual therefore for mill-men to use the largest mouthed machine, and to run it a few hours each day. The rough quartz in blocks as it comes from the mine being ready on the platform near the mouth of the breaker, two men can feed it into the machine and break it up at the rate of five to ten tons per hour, according to the size of the machine.

Breakers have been made larger than any of the above for breaking very large blocks of ore. They are in use at Lake Superior, where they take in masses of ore eighteen inches in diameter by twenty-four in length, and crush them without difficulty. The fragments from these large breakers are received by two or three of the machines of the ordinary sizes and are broken again, so that the pieces will all pass through a two-inch ring. The metallic copper is readily picked out by hand from this broken ore. These large machines would be useful at many mines in California and Nevada, and would permit sledging to be dispensed with. The machine is made without the lever, and works very slowly, but without loss of power; since, when it is not crushing, the only power consumed is that required to overcome the friction, whereas with the heavy stamps, as we have seen, the greatest expenditure of power is when the least work is performed.

There are some modifications of the construction of this machine as here described. In England and France they are commonly made without the lever, the eccentric shaft being mounted on the top of the frame directly over the toggles. A pitman connects the eccentric shaft with



Blake's Rock Breaker, without the lever.

these toggles, and thus produces the oscillating motion of the jaw. This construction is shown by a sectional view as before, one-half of the frame being supposed to be removed. One only of the fly-wheels is represented. This is the form of the machine exhibited at the Paris Exhibition by the manufacturers under the patent in France. The mouth of this machine is expanded, hopper-like, so as to be more convenient for the reception of the masses to be broken. This may be a desirable addition in some cases, where comparatively small stuff is to be broken and is to be shoveled in from a floor lower than the mouth of the machine; but when the mouth is placed, as it should be, on a level with the floor of the dump pile, the hopper is not required.

The rock breaker may be successfully used instead of stamps to obtain either coarse or fine fragments suited to concentration. It has been attempted to increase the fineness of the product of the machine by placing an "obturator" or obstruction, such as a triangular bar of iron, under the outlet between the jaws, arranging it so that it can be raised or lowered by means of screws, in order to diminish or increase the size of the outlet for the delivery of the crushed stuff. The effect of this obstruction is to retain the stuff between the jaws until it is so much broken and comminuted that it will sift through the narrow slits left on each side of the bar. This method of operating may be successful with some materials but involves a considerable expenditure of power. It is also attended with some danger to the machine, since with materials that are easily impacted to a hard mass, the entire space between the jaws may become so tightly filled that some part of the machine must give way. The massive frame of a machine in California was broken asunder in this manner, simply by permitting the outlet between the jaws to become closed by the accumulation of a heap of broken stuff below it. Obturators have been tried; but the discharge from the machines is rendered so slow by them that they have been discarded as not practically valuable. A better way to accomplish the object is to first break the ores in an ordinary machine and then pass the fragments through a machine with a mouth 10 by 2 inches, the jaws of which move only about one-eighth of an inch and make 600 bites in a minute. Machines of this kind have been successfully used in preparing ores for jigs.

At the Churprinz mine, Freiberg, Saxony, two rock breakers are used to prepare the lead ores for the various concentrating machines. One breaker takes the rough ore as it comes from the mine and breaks it up into coarse fragments; these pass to a second breaker with the jaws set nearer together, so as to make fragments small enough for jigging. The finer portions of the first product are separated from the coarse by means of revolving screens.

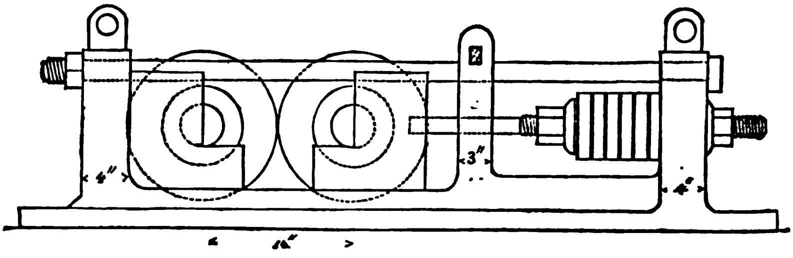
The fragments of ores produced by rock breakers are better adapted in size and shape to the operation of concentration by jigging than the fragments made by rollers and stamps. When set coarse, for breaking quartz to be fed to stamps, the product consists of masses which do not exceed a certain size, and this permits a uniformity in the action of the stamps which cannot be obtained upon quartz broken up by hand, since in the latter case there is great irregularity in the size of the masses, and, as a general rule, the hardest and toughest are the largest. With self-feeding batteries, it is very important that the ore should be uniformly broken, and machine-broken rock is especially well adapted to automatic feeding. When the masses fed into batteries do not exceed a certain size, the wear and tear of grates is less than when the size is irregular. It is easy also with breakers to reduce the whole quantity of the ore to be stamped to fragments very much smaller than can be obtained by hand-breaking, unless by an expenditure of time far beyond what the economy of the breaking will permit. Quartz thus reduced greatly increases the product of a stamp-battery; the stamps have a greater and more effective blow, and mill-men often report that they can work from twenty to twenty-five per cent. more quartz with a breaker than without it, the battery being the same.

The jaws of the breaker are the only parts subjected to rapid wear, and in California and Nevada it is usual to provide the movable jaw with movable faces of hard white iron. These are made about four inches thick, and in such a form that they can be turned over or end for end, until they are too much worn to be longer used. They are secured to the jaw by means of conical bolts, and bedded in zinc or refuse type-metal, in order to have an equal and solid bearing. The forward or fixed jaw can also be reversed in its bed, and is held back to its place by wedge-shaped cheeks on each side. It is usual to make both jaws with vertical coarse corrugations or furrows, so that the ridges of one jaw are opposed to the depressions on the other, thus giving a zig-zag form to the aperture at the bottom. This tends to prevent long and thin pieces from slipping through without being broken; but it is not otherwise essential to the satisfactory operation of the machine, and plain jaws are frequently used.

CRUSHING BY ROLLERS.

Before the introduction of rock breakers, the most common method of crushing was by strong iron rollers, revolving slowly in close contact or pressed together by powerful weighted levers. The stuff was allowed to drop from a hopper between the rollers, and motion having been given to one by means of steam or water power the other roller was carried around by friction. This form of crusher is generally known as the Cornish crusher or rolls, and is much used at the metalliferous mines in Cornwall and elsewhere abroad. One was erected at the Keystone copper mine in Calaveras County, California, a few years ago for crushing copper ore preparatory to jigging.

The figure annexed will serve to give an idea of the general form of construction of the Cornish crusher. The rolls are supported by very strong bearings, in a frame strengthened by wrought-iron bolts. In the construction here shown, the rollers are kept in contact by India-rubber springs, or buffers, of great elastic force, one on each side of the frame. Each buffer is composed of six rubber disks, one inch thick, separated by a disk of iron one-quarter of an inch thick. The necessary initial pressure is obtained by means of two strongly-made screws in the axes



Rollers for crushing.

of the buffers; and by screwing up or unscrewing the nuts on these screws the pressure may be increased or diminished, according to the necessities of the case. It is evident that it would not answer to rigidly fasten the rolls in contact. The accidental dropping of a steel tool, such as a drill or a hammer-head, between them would break the machine; and, moreover, they would not crush as fast and well without a certain amount of yielding to the materials carried through between them. But the use of rubber springs is a novel way of giving the necessary resistance. It is usually accomplished by means of weighted levers, the short arms of which being bent downward press upon a cylindrical bar or follower, which bears directly upon the back of one of the bearing blocks of the roll; or, what amounts to the same thing, the lever is made, by means of rods, to draw the bearing of one roll toward the other, thus keeping the surfaces of the rolls in contact. The amount of the pressure is determined by the extent to which the lever is weighted. This is the usual Cornish method; that by springs of rubber has been tried in Germany. The great advantages of springs are, that the machine occupies less space than when fitted with levers, and that the resistance or crushing pressure increases with the degree of separation of the rolls, whereas with the weighted levers the pressure is constant.

In practice it is found that the product of rolls geared together is greater than when one is carried around merely by the friction of the stuff crushed. It is also usual to have three or more rolls where the crushing is wholly done by rolling. The upper pair are set so as to take in large masses; and to increase the hold of the surface of the rollers upon the masses they are made fluted. The fragments falling from this first pair of rolls are divided between two pairs set below and pressed closely together.

* The diameter of crushing rolls varies from 14 inches to 34 inches, (27 inches is a common diameter,) and the length or breadth of face from 12 inches to 22 inches. The rolls at the mine of Devon Great Consols in Cornwall are very large, having 34 inches diameter, and 22 inches face, and a pressing force on the rolls of 458 hundred-weight, revolving seven times per minute, and crushing 65 tons in 10 hours, at a cost of 2¼ pence per ton.

The annexed tabular statement of dimensions of rollers at various mines will give further details.*

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* Extracted from Hunt's edition of Ure's Dictionary.

Dimensions and product of Cornish rollers at various mines.

Name of mine.	ROLLERS.				Total pressure on rolls.	SIFTER.				Diameter of raff wheel.	Horse power.	Quantity crushed in ten hours.	Cost of crushing per ton.
	Diameter.	Length.	Revolutions per minute.	Crushing area per minute.		Diameter.	Length.	Number of holes.	Revolutions per minute.				
	In.	*In.*		*Sq. In.*	*Cwt.*	*In.*	*In.*	*Sq. In.*		*Feet.*		*Tons.*	*Pence.*
Grassington mines	27	12	5½	5,593	91	21	48	6½	37	14	....	80	......
Minera	14	14	8	4,920	73½	24	42	9	48	10 6-10	6	20	[illegible]
Cwmystwith, No. 1	27	14	4	4,748	78	20	33	9	24	16	....	32	[illegible]
Cwmystwith, No. 2	27	14	4½	5,341	85	24	36	9	24	16	....	35	[illegible]
Goginan	30	14	5½	7,254	39	20	39	9	36	16	....	30	[illegible]
Cwm Erfin	27	14	7½	8,902	293	26	32	9	30	16	....	20	3
Lisburne, No. 1	27	15	6	7,632	180	22	36	12½	30	16	....	42	[illegible]
Lisburne, No. 2	27	15	6	7,632	224	22	36	12½	30	16	....	42	[illegible]
Derwent	27	14	7	8,309	227	22	60	16	....	15	....	60	[illegible]
Goldscope*	14	18	14	11,060	6	....	....	......	....	....	....	25	[illegible]
East Darren	30	18	6	9,996	207	24	36	16	45	16	....	25	[illegible]
Cefn Cwm Brwyno	20	13	5	4,080	84	20	48	16	27½	14	....	20	[illegible]
Lisburne, No. 3	18	16	8	6,432	169	22	36	25	30	16	....	42	[illegible]
Llandudno	18	15	15	12,705	61	....	....	......	....	....	....	30	....
Wheal Friendship	23	12	10	8,670	123	24	36	36	30	13	13	20	[illegible]
Pontgibaud	25	12	12½	12,075	36	22	44	36	60	15	15	17	[illegible]
Devon Great Consols	34	22	7	16,443	458	24†	84	64	21	....	....	65	[illegible]
Fabrica la Constante, Spain	24	15	10	11,300	147	25	45	100	30	15	15	50	[illegible]
Fabrica la Constante, No. 2	27	15	10	12,720	110	25	53	100	30	16	16	50	[illegible]
Fabrica la Constante, No. 3	24	12	16	14,464	84	25	45	3,600	38	(‡)	....	13-20	[illegible]
Fabrica la Constante, No. 4	27	15	15	19,080	93	26	58	3,600	45	(‡)	....	13-20	[illegible]

* Goldscope has two sets of rolls, one fluted, the other plain.
† Two sifters, one 24 inches, the other 22 inches in diameter.
‡ Jacob's ladder, 192 feet.

WEAR OF ROLLS.

The surface of rollers soon becomes much worn; and when made of chilled iron, the irregularity of the chilling is soon made manifest by the unequal wearing away, the soft parts being hollowed out, while the harder remain in ridges or irregular bulges. It is therefore found preferable to use ordinary hard pig iron, or a mixture of hard white iron, similar to that used for the dies and shoes of stamps. The rolls are also made with an outer casing or shell, a short, hollow cylinder, that can be slipped upon the axis or core of the roll, and removed when too much worn. This is usually cast so as to make a firm lock-joint upon the core, or it is keyed by means of two or three keys or wedges slipped into recesses extending through from one side to the other at the line of junction, one-half of the hole being in the core and the other half in the shell.

The annexed figure shows a method of securing the facing upon rolls by tapering keys.* The outer cylinder C C can be slipped off and on the central conical cylinders without difficulty, and is secured in its place by six tapering or wedge-like keys, K K, placed at equal distances around the axis, and firmly held by the strong nuts at one side. This drawing is one-ninth full size. The roll has 14 inches diameter and 9 inches face. In all crushing machines of this description a large amount of the stuff must necessarily be passed through between the rolls several times; for it is evident that when a hard lump of ore passes through and separates the rollers more than is usual, a considerable quantity of stuff drops through without being acted on. The result is the same when the rollers are fed too rapidly; they are kept asunder most of the time, and much coarse and uncrushed material passes through.

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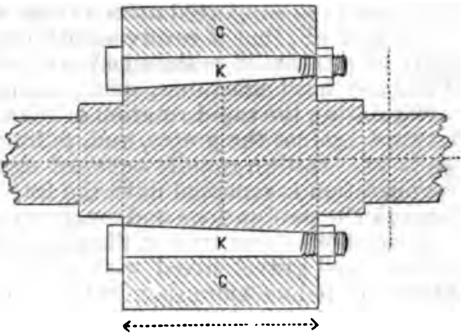
* This figure is taken from the Jahrbuch fur den Berg-und-Hütten-Mann, 1867. Taf. ii.



Roller—Freiberg, Saxony.

The crushed product is always received upon gratings or a revolving screen, by which all the fine or sufficiently broken portions are sifted out. The coarse fragments which require to be again crushed are dropped into a raff-wheel, or elevator, by which they are carried to the upper floor or platform and thrown out, ready to be shoveled into the hopper again. This raff-wheel is usually 15 feet in diameter, and resembles a water-wheel, but is made with the buckets turned inward. This forms a succession of box-like cavities, from which the ore falls out when, by the revolution of the wheel, they are carried to the top and inverted.

Rollers are usually driven by strong gearing, but at the Exposition in 1867 a set of rolls exhibited by Messrs. Huet & Geyler were driven by a belt, as is also a machine at Freiberg, in Saxony. M. Huet mentions rolls with as great a diameter as $1^m.20$; but the rollers in machines of their construction, driven by a belt upon a shaft carrying at the opposite end a small pinion, working into a large spur-wheel upon the end of the shaft of one of the rollers, did not exceed $0^m.09$ in diameter.

The hoppers of rollers for crushing large quantities of stuff are usually made large enough to hold a ton.

LUNDGREN'S PULVERIZING BARRELS.

An apparatus for fine crushing by means of rolling in a cylinder with a great number of small balls of hardened iron, was erected and used for a time at the Benton Mills, upon the Merced River, but was finally abandoned. The cylinder or barrel used was made of boiler iron, lined on the inside with shoes of hard iron, one inch thick. Its length was three feet and diameter five feet. The material, consisting of the battery sands, was screened and introduced in charges of 650 pounds. Some 2,000 pounds of chilled iron bullets, half an inch in diameter, were then added, and the whole made to revolve on its axis slowly, about 26 revolutions in a minute, for one and a quarter hours, at the end of which time the sand was reduced to a fine powder. The wear upon the balls is said to be very slight.

CRUSHING BY PERCUSSION—CENTRIFUGAL CRUSHERS.

For crushing minerals and other hard substances by projection from a revolving wheel or disk, an apparatus was devised and operated for a time by Messrs. Whelpley & Storer, in Boston, Massachusetts. To the part for coarse crushing they gave the name of *whirling table.* This is a saucer-shaped mass of metal, three and a half feet in diameter, weighing 800 or 1,200 pounds, and revolved horizontally with great velocity, as great as 1,025 times per minute. This table or disk forms the bottom of a circular cast-iron stationary tub, eighteen inches deep, the sides of which are perforated so as to allow small fragments to pass out. The table is so supported upon a vertical shaft, with a steel pivot resting in a cup of oil, that it revolves with but little friction, and the high velocity of rotation is maintained with but little expenditure of power. When any hard substance, such as a mass of quartz, is thrown into the cavity during the rapid rotation of the table, it is at once forcibly thrown outward against the grates, and, falling backward in fragments, these are in turn thrown rapidly outward again by the centrifugal force, and the operation is repeated until the fragments are small enough to pass through the perforations and escape to an outer chamber. If these perforations are half an inch in diameter, the fragments of the quartz will be like small gravel mixed with sand. It is claimed that one of these tables will reduce more than 200 tons of ordinary quartz in pieces from three or four inches in diameter to the size of coarse gravel in twenty-four hours. The inventors allow, in practice, an average of ten-horse power for the full working of one of these tables, and they rate the expenditure of power at about one and a half-horse power per hour for each ton of quartz. To obtain this result the velocity of the table must exceed 1,000 revolutions per minute. Blocks of hard white iron, such as Franklinite, are bolted upon the outer edge and face of the table. These, at high velocities of rotation, first strike the mass to be broken and splinter it before it reaches and wears the surface. With low velocities the machine is rapidly worn and injured, by the dragging of the stone over its surface. With the higher velocities only the edges of the hammers or iron blocks are worn, and these blocks last a much longer time in proportion to the amount of work done. The balance of this revolving table is regulated by bolting pieces of iron to its under side. This machine is not intended to be used as a *pulverizer*, but rather as a breaker, taking stuff three to six inches in diameter and reducing it to the condition of mixed sand and gravel, with a small percentage of dust. For carrying the reduction still further and gaining a product as fine as dust, another form of centrifugal apparatus, called the *pulverizer*, is used.

The pulverizer, as described by the same inventors, consists of four parts or elements: 1. An automatic feeding-mill, which furnishes a regular and constant supply of the material to be pulverized. 2. An iron drum or cylinder, containing an air-wheel, which converts the sand or gravel into dust, chiefly by the action of the particles upon themselves in the rotary currents of air created by the wheel. The material can be retained in the cylinder until it is completely reduced. 3. A fan-blower, by which the dust is drawn from the pulverizing drum as fast as it is generated. 4. The dust so drawn off is received and collected in a chamber or series of chambers.

The pulverizing cylinders, in use for two years or more, chiefly in crushing bones, were forty-two inches in diameter and eighteen inches in breadth. They had twenty-four paddles or arms of hard white iron, six inches long by three and a half in breadth. The revolution was in a vertical plane. It was found by experience that the proper velocity for economical results was about 1,025 turns in a minute. "This will require fifteen horse-power to produce 1,500 pounds of quartz powder, four-fifths of which should pass through a sieve of one hundred threads to the linear inch." The inventors further state that a very fair estimate of production allows one hundred pounds per hour of average dust to the horse power.

Efforts have been made in California to perfect a form of rotary crusher for dry crushing, and the mining public is indebted chiefly to Mr. Moore, of the Vulcan Foundry, for persistent efforts to solve the problem of a cheap and durable machine for dry crushing upon this principle. Much money was expended, and for a time it seemed as if success had been attained, but the practical difficulties inherent in this method proved insurmountable and the efforts to perfect the apparatus ceased. One of the chief difficulties was found to be the excessive vibration of the revolving disk at the required high velocity, the result of unequal wearing. The details of the experiments made at the Vulcan would form a very interesting and valuable contribution to mechanical engineering, and it is regretted that expected details on the subject have not been received in time for insertion here.

CHAPTER LXXIX.

STAMPS AND STAMP MILLS.

The stamp is the oldest, simplest, and most effective machine for crushing ores to powder. The breaker and Cornish rolls, already described, act by direct slow presure; while stamps in falling acquire momentum, and strike sharp, quick blows upon the mass to be broken.

The iron stamp batteries, now in use upon the Pacific coast, are made chiefly at San Francisco, and have been carried to a high degree of perfection by the joint efforts and experience of the mill-men and the metallurgical and mechanical engineers. It is but just to state that the stamp batteries made there are superior for gold and silver working to those in any other part of the world, and that they have become the type to be followed in the construction of batteries in Chicago, New York, and elsewhere.

It is now very rare in California to find the old-fashioned timber, square-stem stamp lifted by a wooden or iron cam set into a large shaft. Some that were erected in Grass Valley several years ago are still in existence; but the round stamps with cylindrical iron stems, free to rotate in the supports or guides, are now used almost exclusively in California and Nevada.

The whole stamp is composed of the following parts: the stem, the tappet, the stamp-head or socket, and the shoe. The mass of hardened iron on which it falls is called the die, and this is placed in the cast-iron box called the mortar.

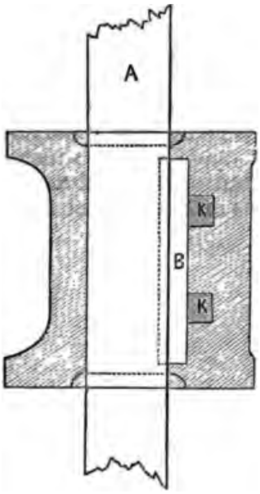
The stem is usually made of 3-inch or 3½-inch round iron, from 10 to 12 feet in length, and turned off in a lathe and finished so as to be truly cylindrical, and equal in diameter in every part except for a few inches at the lower end, which is made tapering, so as to fit into a conical hole in the top of the head.

The tappet, or lifter, as it is sometimes called, is secured upon the upper part of the stem, and forms a projection three or four inches wide, under which the cam catches and lifts the stamp.

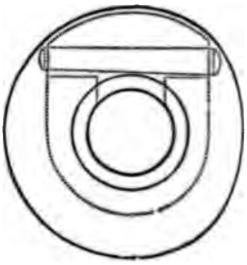
The first of the annexed figures is a vertical section of the tappet as it appears fixed upon the stem A; and the second an end view or plan, the contrivance for securing it to the stem being shown in both.

The tappet is made of cast iron, and weighs from 60 to 70 pounds. It is alike at both ends, so that when one becomes worn it can be reversed upon the stem. Formerly the tappets were attached to the stems by means of screw threads cut upon the latter, the tappet being screwed down as a nut upon a bolt; afterward key seats were cut to receive a transverse key; but these methods have been superseded by the much more simple and convenient device invented by Zenas Wheeler, of California, which has given his name to the tappet.

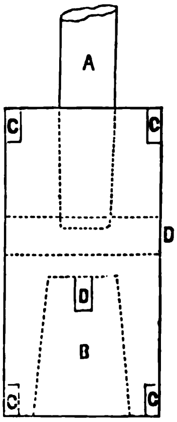
The tappet is cast with a rectangular recess in one side of the hole, for the stem. Into this recess a "gib," B, is placed. This is a rectangular block of wrought iron, flat on one side but hollowed on the other, so as to fit the curvature of the stem. Two transverse slots or openings at the back of the recess are provided for keys or wedges K K, by which the "gib" is wedged powerfully against the stem, so that the tappet is firmly secured at any desired place upon the stem. Thus no key seat or change of the form of the stem is required, and the tappet can at any time be removed without difficulty merely by driving out the keys.



Stamp Tappet—section.

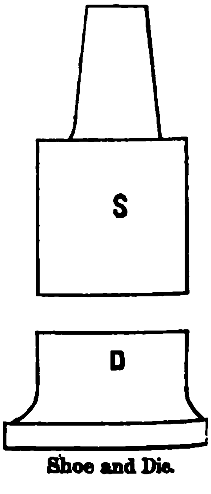

Stamp Tappet—plan.

The stamp-head or socket, as shown in the annexed figure, is cylindrical, and made of the toughest cast iron, strengthened with wrought iron hoops or bands, C C, C C, at the top and bottom, shrunk on while hot. It is cast with two conical openings, or sockets, one in each end, the upper being for the reception of the tapered end of the stem A, and the lower and larger opening, B, for the shank of the shoe. D D represent transverse rectangular openings, or key-ways, by means of which steel wedges can be inserted, so as to bear either against the end of the stamp-stem or against the end of the shank of the shoe, for the purpose of driving either out. This is often necessary for the shoe, when by wearing it has become too thin, and has to be replaced with another. The stamp-head is made in this form for the purpose of facilitating the removal of the shoe. With proper care the socket lasts for years, and after being once attached to the stem need not be removed; but the shoe wears out in a few weeks.



Stamp-head.

The form of the shoe is shown by S in the annexed figure, and the die by D. Both are round, in horizontal section, and are cast of the hardest and toughest white iron. The shoes are usually eight inches in diameter across the face, and six inches in length or height from the face to the shank. The die corresponds in diameter at the face, but they are often made with a broader face, sometimes square, and fitted into recesses in the bed of the mortar. They



Shoe and Die.

re made of the same iron as the shoes, and are renewed as fast as worn out.

It is usual for the manufacturers to ship these different parts of the tamp disconnected, since their construction permits of their being nited with ease, when they are to be placed in the battery. In order o fasten on the tappet, we have seen that it is only necessary to slip it n the stem and then wedge it fast by means of the keys and the gib. To attach the stamp-head it is only necessary to place the socket upon he die in the mortar, and let the tapered end of the stem drop vertially into it. A few blows with a hammer upon the upper end of the tem will wedge it firmly into the head, and it is made tighter by allowng it to drop, head and all, upon the die. This is regarded as a permanent connection; but with the shoe the case is different, and, to render it less difficult to remove this part when worn out, the shank, beore being inserted into the socket, is covered with strips of pine, about one-quarter of an inch thick. These are held in place by a string, while he shoe is placed in its proper place upon the die, and the stamp-head is allowed to fall upon it. It becomes tightly wedged in the conical ocket, and may be raised with the stamp. After dropping a few times pon the die, (protected by a bit of plank,) it is driven "home;" but here must be a little space left between the top of the shoe and the ower surface of the stamp-head. A stamp thus put together, with a hree-inch stem and a 200-pound head, will weigh about 620 pounds, he tappet weighing 70 pounds and the shoe 95 pounds.

The smooth, round stem of the stamp permits it to revolve in rising r falling, so that all sides of the shoe are turned in succession toward he side where the quartz or ore is fed in, this being the side where the tamps with square stems are most rapidly worn away, because on this ide the coarse material to be crushed is most abundant. By turning he stamp constantly in the battery this wear is equalized. Shoes hould not be allowed to remain in the head until they are entirely worn out, as the wear will be partially upon the wrought iron band of he head, and thus weaken it. When no more than one inch, or threeuarters of an inch in thickness is left, the old shoe should be wedged ut and a new one put in.

It is very important that shoes and dies should be equally hard hroughout, so that they may wear away equally in all their exposed arts.

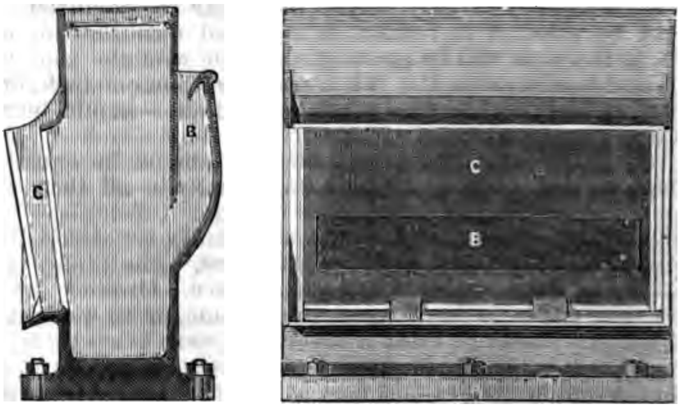
To manufacture shoes and dies of good quality for stamp batteries equires considerable judgment and experience. The proper selection nd mixture of the iron is of first importance. Ordinary iron when hilled in iron molds is hard upon the outside, or to a slight depth, while within this hardened crust it is soft, and soon wears away, so that shoe made in this manner becomes hollowed out like a saucer, as soon s the hard crust or chill of the face is cut through. A shoe made of ard white iron, weighing 95 pounds, will last for six weeks, sometimes onger; but ordinary iron will wear out in a month. A die four inches hick, and weighing 60 pounds, will last five or six weeks. A worn-out hoe and die will not together weigh more than 30 to 38 pounds.

This, however, depends upon the judgment of the mill superintendent. ome mill-men use the shoes and dies much longer than others. The bove is the experience at the Princeton mill of 24 stamps, on the Mariosas estate. These stamps weighed about 500 pounds, and crushed about 5 tons of hard quartz in each twenty-four hours. The actual wear of hoes and dies was found to be about 1.54 pounds of the iron per ton of ore crushed. The wear of the shoe alone is generally estimated to be from one-half to one pound per ton of hard quartz crushed.

BATTERY MORTARS.

In the old-fashioned batteries, the mortar or coffer in which the stamps act is made of plank, bolted to a timber frame and lined with sheet-iron, and fitted with a cast-iron bed or shallow trough at the bottom, which serves as the die or anvil. But in working gold ores it becomes of the first importance to prevent all leakage in the batteries, especially where quicksilver is used. With wooden mortars this is next to impossible, particularly if they ever remain idle for a few days or weeks, and are allowed to dry. It moreover requires considerable time and skill to construct a mortar of wood in the most approved form, and in a region where time is so valuable as it is in all newly discovered gold and silver regions, it is a great advantage to have mortars already made, which only require to be set upon a suitable foundation to be complete. Cast-iron mortars fulfill all the required conditions, and they are now and have been for many years in general use in the mines of the West. They are made in many forms, and of various thickness and weight, by different establishments, but the following notices of the principal forms made by H. J. Booth & Co., at the Union Iron Works, San Franciso,* will suffice to show the general style of construction of all. They weigh from 2,000 to 4,000 pounds, and are cast in one piece, with the exception of the section mortar, intended for transportation in pieces in mountainous regions.

High mortar.—The mortar in common use upon the Pacific coast is known as the high mortar, and is here represented in cross-section and in front view.



High Mortar.

It is four feet long, four feet high, and weighs about 3,000 pounds. They can be made for three, four, five, or six stamps; but five stamps to each mortar are found to work best. The ore to be stamped is fed through the longitudinal opening B at the back of the mortar, and falls upon the dies (not shown) ranged side by side in the bottom.

All the rock is supposed to have been made small enough by the breaker to pass through the narrow opening at the top. The large ng in the front of the mortar is intended for the screen, made ssian sheet iron, punched with fine holes. This is screwed or d securely to a wooden frame, which is slid into grooves C in the n, cast in each end of the frame, and is firmly secured there by vedges of iron. Two lugs or ears of cast iron, placed at equal dis- s at the bottom of the opening in the front of the mortar, serve stain the screen-frame in front. The whole mortar is securely l down to the foundation through the heavy flanges cast upon the n.

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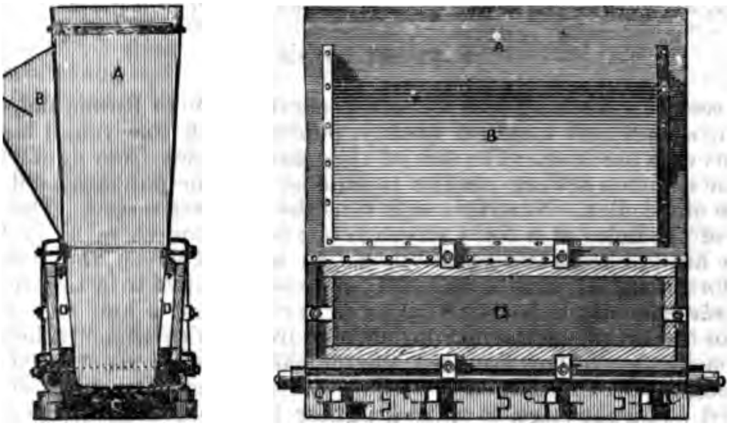
* I am indebted to this firm for original working drawings from which the figures of batteries and stamps have been reduced.

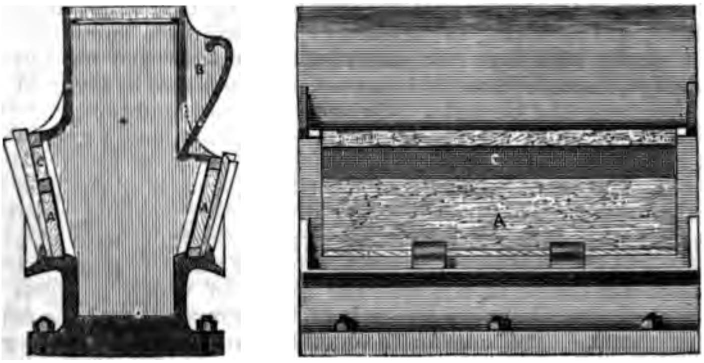
ion mortars.—Mortars which have to be transported into places lt of access are made in sections so that they can be taken apart acked upon the backs of mules. These are called section mortars, heir construction is shown in the accompanying figures. This



Section Mortar.

r, like the preceding, is for five stamps, and is four feet long. pper portions A A are made of boiler iron. The feed opening is . at B. There are double screens D D, one on each side. The d of securing these screens to the openings by means of movable r clamps, is also shown. The bottom is cast in sections c c c, and are accurately fitted together with tongued and grooved joints, l, and held by heavy iron bolts running through them from end , and secured by strong nuts upon the outside.

nell's mortar.—A form of mortar known as Donnell's is shown by



Donnell's Mortar.

the figures. The ore, as in the other mortars, is thrown in at the feed opening B, in the section, and the delivery is through one of the two openings in front and in the back. The screen C is narrow and is placed high above the dies, and occupies only a part of the opening in front. The lower portion of this opening and the opening in the back is closed by a door of wood A A, covered on the inside by a sheet of amalgamated copper which catches and retains the particles of gold. By removing the screen C, and making the door A higher, it may be used as a float mortar.

Dry mortars.—Wet stamping or crushing is general in California. Mortars for dry crushing are exceptional in that State; but the silver mills of Nevada, crushing ore which has to be subsequently roasted, require this form. Screens for the latter are placed higher and are made wider, and wire-cloth is substituted for perforated iron plates.

BATTERY SCREENS.

Screens for working ores wet are generally made of Russia sheet iron, of the softest and toughest quality, punched with fine round holes by means of a machine. The size of these holes varies from number nine of the common sewing needles to number one, the punches used being made of needles. Number one is thus the coarsest screen. The diameter of the holes of a No. 4 screen is one-twenty-fourth of an inch, and there are 144 holes in a square inch. In a No. 6 screen, the holes are one-fortieth of an inch in diameter, and there are 324 in a square inch. The screens vary in length from three to three and a half feet according to the length of the mortar, and are from ten to fifteen inches wide. When wooden frames are used, the punched screens are tacked on at the edges with common carpet tacks, a strip of baize or blanket being placed under the edge, to make a tighter joint and to facilitate the removal of the screen when worn out. The screens are also secured in iron frames, made with cross-bars so as to sustain them.

Sometimes the holes in the sheet iron are made in the form of narrow slits, about one-third of an inch long, with a view of increasing the rapidity of the discharge of the stamped stuff. For the same purpose, the screens are not placed vertically in the mortars but are inclined foward at the top, as indicated in the figures of mortars, by the recess for the reception of the screen frames.

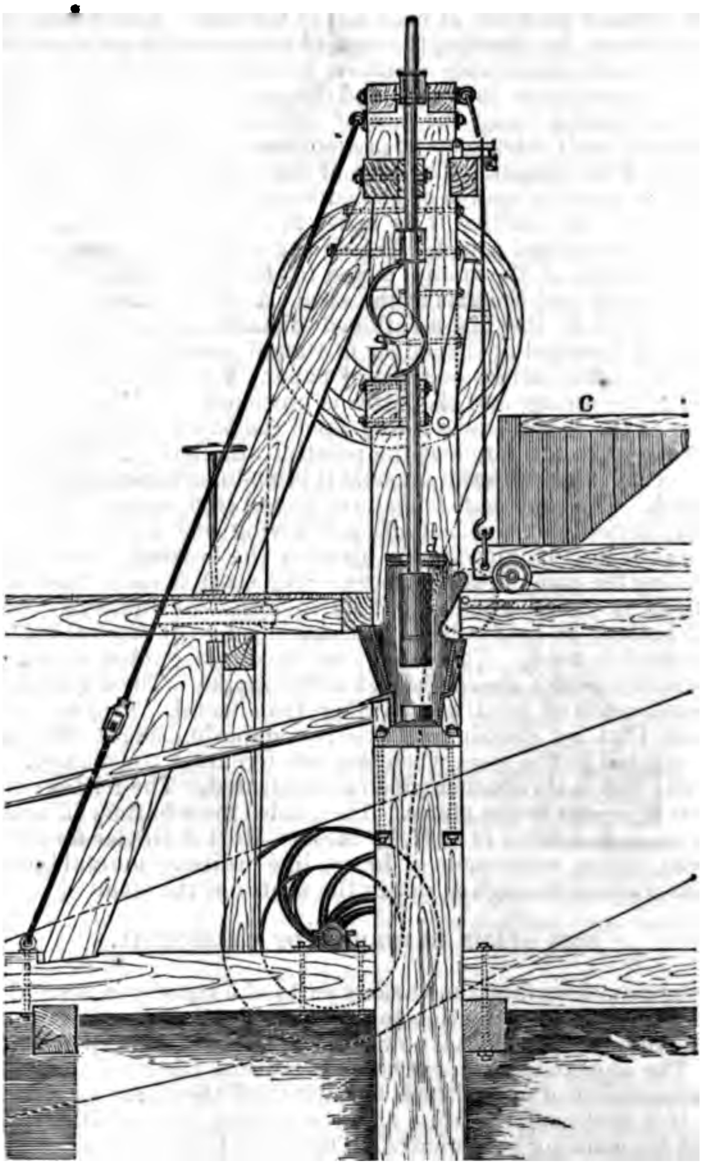
CAMS AND CAM-SHAFTS.

The stamps of California batteries are lifted by iron cams, keyed upon iron shafts, and revolving at the side of the stamp stem under the tappet. Wooden shafts with iron cams inserted are now seldom used upon the Pacific slope, though formerly common, and used also in the gold region of the Carolinas and Georgia. The iron cams are made single, with one arm, and also double, with two; but the single cam is now generally preferred, as it permits the shaft to be brought very near to the stem and thus brings the commencement of the lifting surface of the cam nearly under the tappet. Cast iron is used; the bearing surface, about three inches wide, is made smooth by grinding; and the hubs are strengthened with wrought-iron bands. The proper form of the curvature of the cam is a modified involute of a circle, the radius of which is equal to the horizontal distance between the axis of the cam-shaft and the centre of the stamp-stem. The curvature should be increased or made greater than the regular involute, at each end of the cam. This is done so as to ease the contact, by allowing the cam to commence to act upon the tappet at the least practicable distance from the axis of the cam-shaft, where the concussion is least, and to prevent the outer end from scraping or tearing along the face of the tappet. This end is also cut out on one or both sides so as to prevent the corner from cutting the circular edge of the tappet. The face of the tappet should always be at right angles with the radius of the curvature of the cam at every part of its course. In practice it is usual to construct the cam-curve by means of a string and pencil. This string must be as long as the required lift or rise of the stamp, added to the distance between the axis of the cam-shaft and the axis of the stem. A circular disk of wood, with a radius equal to the last-mentioned distance, is provided, and, the string being fastened at the edge, is wound upon its periphery. It is placed upon a flat surface or sheet of paper; a pencil is fastened at the free end of the string, and the latter is unwound, being kept taut, while the point of the pencil traces a line upon the paper until the string becomes tangent to the circle at the point of attachment. This gives the involute with sufficient accuracy, and it is modified in practice as already mentioned. The cam-shaft is made of round iron, usually 4½ inches in diameter, turned and finished off, and having one and sometimes two key-seats cut in it longitudinally between the bearings for the purpose of fastening the cams in their places. One shaft is sometimes made to run fifteen or more stamps; but an independent cam-shaft for each 5-stamp battery is preferable. If there is a line of several batteries a counter-shaft is used. The stamps are held and guided in position in the mortar by guides above and below the tappet. These guides are, by preference, made of hard wood rather than metal. They are made in halves so that by dressing off the two opposing edges they may be readily refitted to the stem when they are too much worn away. Oak is preferred; but in its absence pine is substituted. The friction of metal guides is injurious to the stems. The guides for a battery of iron stem-stamps made in France in 1867, by Messrs. Huet & Geyler for the mines of Serena, Spain, were made of brass, like ordinary journal boxes, and the cams worked through a slot in the centre of the stem

THE STAMP BATTERIES OF CALIFORNIA.

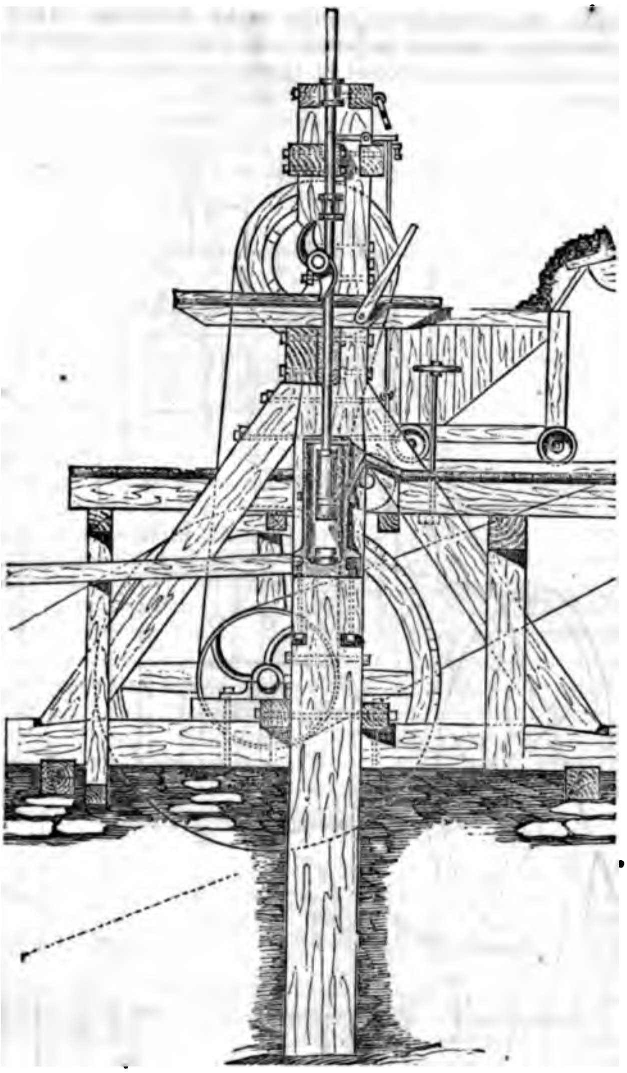
Having now described the various parts of a battery in some detail, it may be well to direct attention to their combination so as to form a complete stamp-battery such as is now in use in the best mills upon the Pacific slope. The annexed figure will serve to indicate the general appearance and arrangement of one of these batteries and the frame for its support.

This is a sectional elevation of a self-feeding stamp battery, as constructed for working gold quartz. The frame is of pine timber securely braced and held by tie-rods. One end of the iron mortar is supposed to be removed so as to show the interior. The hopper-shaped box, C, is the self-feeding arrangement. It is shaken at each blow of the stamp by means of an upper tappet which strikes upon one arm of a lever, by which motion is communicated to the forward end of the feed-box, C. It will be observed that the cam-shaft is driven by a belt running from a counter pulley below. The double cam is shown, and the movable arm or bar used to hold or "hang up" the stamp when the battery is not in action. The scale of this drawing is about one-quarter of an inch to one foot.



Battery for working gold quartz.

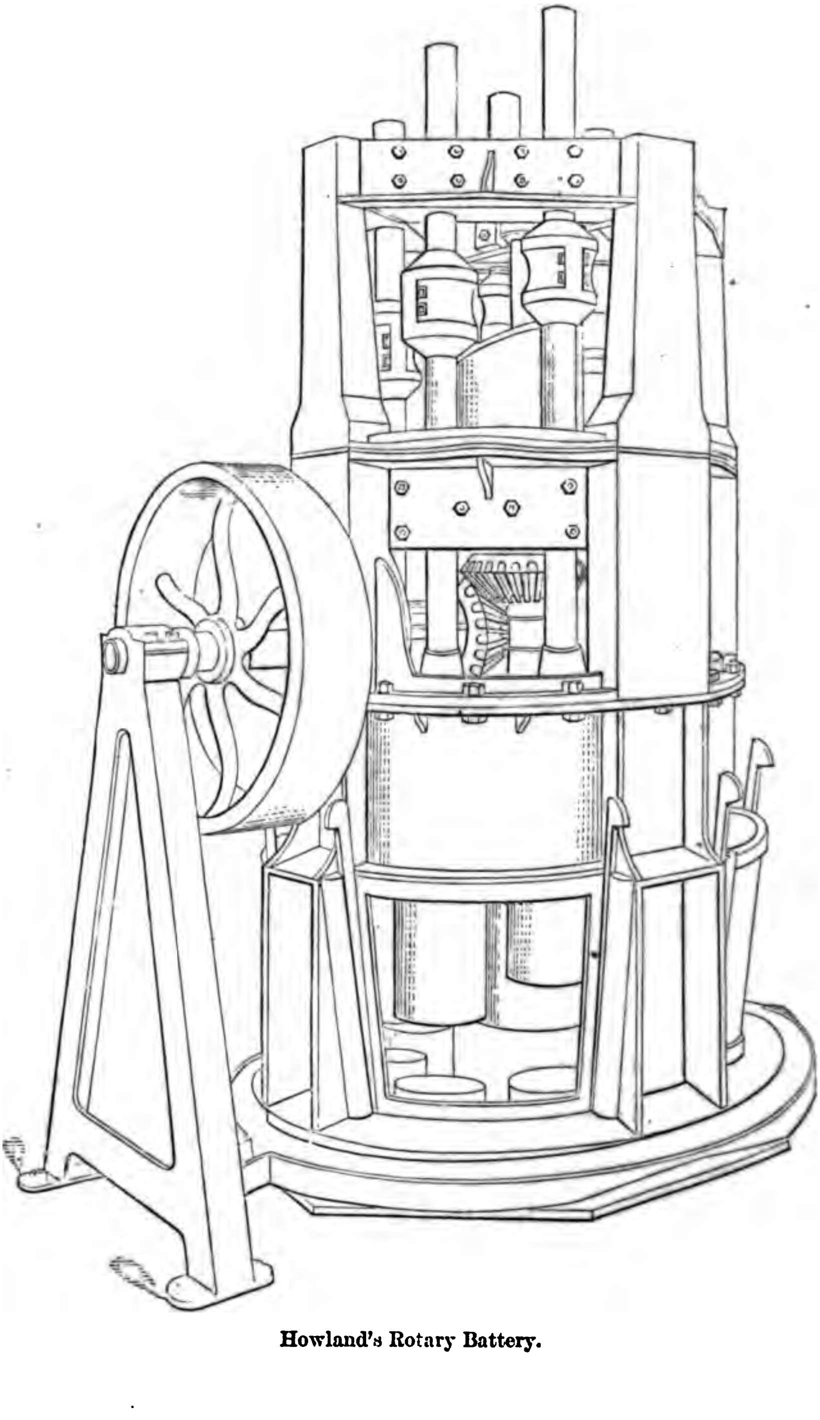
The next figure shows the construction of a battery and its frame for a wet-crushing silver mill. The ore, after passing through a Blake's rock-breaker, is received in the feeding box mounted upon rollers. From this it drops into the mortar. This mortar is made with grates upon each side. The stamped ore, after settling in vats, is worked by charges in pans. The framework of this battery is different from the preceding, but the arrangements for feeding, hanging up stamps, &c., are similar.



Wet-crushing Silver Battery.

HOWLAND'S ROTARY BATTERY.

This is a compact and portable form of battery, designed and patented by W. H. Howland. It was introduced to the notice of the mill-men of California and Nevada several years ago, and was at first used to a considerable extent, but was gradually replaced in nearly all the mills by the ordinary straight battery. These batteries were early adopted by Mr. A. B. Paul, in the mills erected by him below Gold Hill, and he has recently given his opinion of their merits as follows: "No act of mine in mining has been more criticised than the adopting of these batteries in my Washoe operations. Their adoption was no blind work, as I had used them for three successive years previous, and in no test with other mills was I beat in returns. I had then, and have now, great faith in their principle. It certainly is in the right direction. They will, in time, I am confident, become popular, especially when introduced with the *later improvements*, on account of their simplicity, efficient working, and cheapness."



Howland's Rotary Battery.

It is claimed by the inventor that very great improvements in the construction have recently been made, based upon the experience of seven years of constant working of the old style of the rotary iron battery. It is now offered by the Miners' Foundry to miners as a "new and highly improved rotary quartz mill," of less cost than the straight batteries, and requiring less power.

The construction is shown by the figure, page 666. The whole battery is of iron; the stamps are set in a circle around a central vertical shaft carrying the cams. Motion is imparted to this shaft by means of bevel-gearing. The cams are thus carried round horizontally, and lift each stamp in succession. These rotary batteries are cast in three sections. The first section has the mortar or base, screen frames and feed openings in one piece; the second section contains the lower guide boxes, (which are of wood,) driving gears, and cam-wheel; the upper section contains the upper guide-boxes. These three sections are bolted together, with thin pieces of wood-packing between each. The stems, tappets, stamps, shoes, and dies are the same as in the ordinary cast straight batteries.

The openings for delivery through screens of the ordinary construction are seen at the base. The stamped stuff collects in the annular trough, cast in one piece with the mortar, so that there is no leakage, and is discharged by a chute at one side. It is claimed as one of the advantages of this improved form that there is more metal in the mortar or base than in the old form of rotary battery, and that the leakage at the base of the column, the jar and loosening of bolts, and the wear of guide-boxes, formerly complained of, are now entirely obviated.

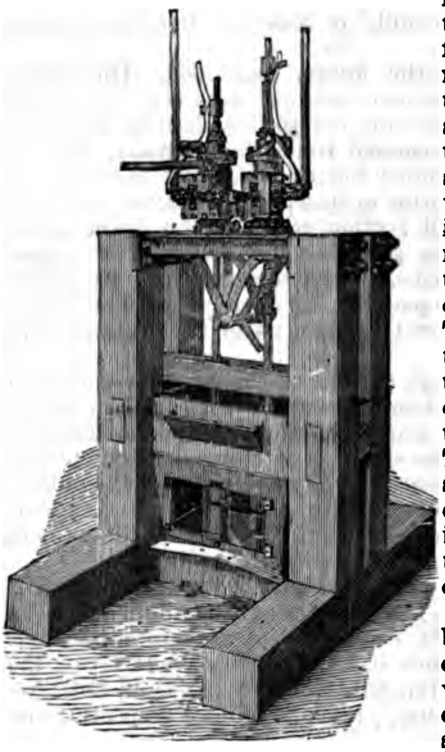
Its compactness and lightness as compared with the ordinary straight battery, and its being complete in itself, not requiring timber framing and supports, commend it specially to those who wish to work their ores in districts remote from supplies of timber. Mr. W. D. Gray, the superintendent of the mill of the Imperial Company, at Gold Hill, Nevada, writes to Mr. Howland, February, 1869, as follows respecting the rotary battery:

> Yours of 10th instant is at hand, in which you speak of having just finished and shipped for White Pine an 8-stamp rotary battery, made from a new and improved set of patterns. For a new country, where lumber is scarce and labor necessarily high, there is no battery now in use that will equal yours. The little time required to set it up ready to run is an important consideration. The greatest objection urged against the rotary battery has been the cost of keeping them in repair, compared with the straight battery. But my experience for the last eight years proves this a mistake. The annual report of the Imperial Silver Mining Company shows quite a percentage in favor of the Gold Hill mill (five 8-stamp rotary batteries) over the Rock Point mill, both in cost of repairs, expense of running, and yield per ton of ore worked—the first of which I have had charge of for the last five years. The Rock Point mill, run by water, has straight batteries. I think this comparison can be fully substantiated, as far as expense of repairs is concerned; also as compared with any other mill run in Storey County for the last five years.

The mill above referred to was designed for the Grant District, and weighed, when complete, less than six tons. The stamps weighed 600 pounds each, and were designed to make 100 drops per minute. When working up to its full capacity it will crush from twelve to sixteen tons, *dry*, in twenty-four hours. The total height of the machine is about eight feet, and the weight of the mortar is 3,000 pounds.

WILSON'S STEAM STAMPS.

One of the most successful of the attempts to apply steam direct to the stems of stamps has been made by Mr. T. R. Wilson, of Philadelphia, Pennsylvania, whose mills have been in practical operation at several of our western mines. The general appearance and arrangement of the battery is shown by the figure. Steam is taken directly by a two-inch pipe to a short cylinder around the stem of each stamp above the frame and by suitable valves is made to act under or above a piston upon the prolongation of the stem, so as to either raise or throw down the stanp at will. The force of the steam can thus be added to the weight and momentum of the stamp in falling, in order to increase the rapidity and force of the blows, and thus to give an increased product of stamped ore in a given time. Two stamps are placed in each battery. The mortar is made in the usual form for double grates, one on each side, but is heavier than those intended for ordinary stamps. The two stamps are intended to strike about 400 blows per minute, or 200 blows to each stamp; and it is claimed by the manufacturers that they will stamp fine one ton or more of hard rock in one hour.



Wilson's Steam Stamps.

It is automatic in its action, cams being adjusted upon the upper ends of the stems and operating the valves as the stems move up and down. The following data will show the force with which the stamps may be made to strike:

	Inches.
Diameter of cylinder, 5⅝ inches, area in square inches	24.8
Diameter of upper piston rod 2 inches, area in square inches	3.1
Total area of piston for down pressure of steam	21.7
	Pounds.
Multiply by pressure of steam in the boiler, (70 pounds)	1,519
Add weight of stamp and stem	492
Whole force of blow	2,011

This shows a force of about one ton, and it is so considered by the inventor. The steam-pressure at the battery is usually less than stated, say 65 pounds. The length of the cylinders is 7½ inches, and the thickness of the piston is 3 inches; there is therefore room for an extreme stroke of 14½ inches, but an allowance must be made for the wear of shoes and dies. In setting up the machine an allowance of five inches is made for this, a space being left of this length under the piston, when the shoes and dies are new. This leaves a space of 9½ inches for the movement of the piston; but in practice it is not run over 6 inches, this stroke or fall of the stamp being found to be quite sufficient. To vary the length of the stroke, the position of the cam is varied upon the top of the stem, being screwed down for long strokes and upward for short strokes. The screw thread is not cut so low as to make it possible for the piston to strike the cylinder-head.

The dies are made in the usual way, and are recessed to a depth of an inch in the bottom of the mortar, which must be bedded upon a firm foundation.

ADAPTATION OF STAMP BATTERIES TO QUARTZ CRUSHING.

The action of stamps is peculiarly favorable to the extraction of free gold. The metal, except in rare cases, is best liberated by simply breaking up the quartz without any grinding or rubbing. Trituration rapidly cuts up and disseminates the gold in such an extreme state of division that it passes off in the water and cannot be recovered. These observations apply in general to all ores. The product from stamps is more granular and contains less fine powder and dust than that of a grinding mill. This is due not only to the manner in which the stuff is acted upon, but also to the manner in which it is delivered. The constant swash of the material and the dash of the stamps carry the finer portion away, and only those portions remain which are too coarse to pass through the screens. Another advantage in respect to gold or any other malleable metal is that a direct blow merely flattens the particles without wearing them away, while trituration cuts and wears them away. Gold, also, when in coarse grains, by its great specific gravity settles in the lower part of the mortar under the sand around and between the dies. The swash of the sand serves to keep the amalgamated copper plates clean and bright, and thus in the best condition to seize and hold the freshly liberated gold particles thrown into contact with them.

Another reason of the great practical efficiency of stamps over other forms of apparatus for fine crushing is the fact that a wide range in the size of material fed is admissible. They act upon either fine or coarse material. Grinding machines require rock to be first broken up so that their surfaces may act upon as many fragments as possible at the same time; but with stamps, the rock fed may vary from mere sand to pieces three or four inches in diameter. All are crushed together, without clogging or causing an increased strain upon the driving-gear, however rapidly or irregularly they are fed. The constant flow of water through the mortar carries out the fine material and leaves the coarse to be further acted upon.

DETAILS OF SEVERAL STAMP MILLS.

In further illustration of the construction and working of stamp mills, the following details regarding some of the principal mills of California may have some value. They are drawn from the manuscript notes of the writer, made at different times during visits to the mines and mills.

The 40-stamp mill at the Hayward Mine, Sutter Creek, Amador County, had in June, 1866:

Stamps in batteries of five stamps each. Battery boxes of wood. Low trough mortars of cast iron. Weight of stamps, 450 pounds each; eleven inches lift; 80 blows per minute. Dies seven inches across face; both dies and shoes are used until they are completely worn out, (from four

to six weeks.) Height of discharge-opening eleven inches above dies; different heights from nine to fourteen inches have been tried, but the height of eleven inches has been found to give the best results. Screens on one side of the battery only and made of the best Russia iron, No. 11, punched with vertical slits a little over half an inch in length. These screens are narrow, the delivery being through a vertical height of two inches only. As the openings in the screens wear most rapidly upon the lower ends, the screens are reversed after each run.

The amalgamation is effected in battery, the gold collecting chiefly upon an amalgamated copper-plate at the delivery, directly back of the screens. This plate is four inches wide and is slightly inclined inward. The amalgamated particles of gold accumulate upon this plate in a thick even coat which can be removed in heavy cakes by the aid of chisels. This plate must be placed at the proper angle with due regard to the velocity of the movement of the stamps and the quantity of water used. The pitch must be just sufficient to keep it clear and no more. The apron, outside, is not made of copper, as is usual, since the progress of the amalgamation can be judged of better without it.

It is found that the quartz crushes faster when there is not an over-supply of water. Eighty drops of the stamps per minute are necessary to keep the materials properly in motion.

When the amalgam is collected, the stamps are "hung up," the screens are removed, and the whole of the interior of the battery and mortar is accessible. The amalgam found upon the copper plate is chiseled off, and the fragments are collected in iron vessels. It is then broken up and softened by the addition of a little quicksilver. By this means any fragments of iron and admixed grains of pyrites are floated out to the surface and are washed away. It is then strained through a piece of coarse unbleached cotton cloth, sufficient of the liquid amalgam being taken to give a ball of hard, dry amalgam weighing about fifteen pounds. At the clean-up witnessed by the writer, about 185 pounds of dry amalgam were obtained in 15-pound balls.* It was then retorted in an ordinary pot retort with a long beak or tube of wrought-iron pipe. The retort being luted and closed is placed in a rude furnace in the open air, and a wood fire built on the top and increased gradually. It is estimated that the amalgam will yield about one-third of its weight of bullion, or about $95 in value, to each pound of amalgam.

At the Eureka Mill, Grass Valley, in 1866, there were 20 stamps, 815 pounds each, 10 inches fall; screens raised three inches above die-face, and five inches in front. Worked well; did not cut. No amalgamation in battery; the sands collected on blankets and copper plates amalgamated below the blankets. Twenty tons crushed in eleven hours.

Allison Ranch in 1865 worked 12 stamps of 1,000 pounds each, 10 to 12 inches lift, crushing about 40 tons a day. These stamps were made upon the old-fashioned pattern, with wooden stems and square heads. No quicksilver was used in the battery; the pulp flowed over blankets, and the sands deposited were worked in Attwood's concentrator, and the waste passed through the Lawton pan. Fourteen Lawton bowls were used, and were said to save from $1,000 to $1,200 a month. Sulphurets were concentrated in a long rocker, a square box-trough, giving from five to seven tons a week of concentrated sulphurets.

At the Merrimac Mill, of 10 stamps, the amalgamation was effected in battery. The copper plates are one-eighth of an inch thick and about four feet long. Stamps weigh 740 pounds each; 3-inch stems, 16 inches long; 11 inches to 12 inches lift; delivery four inches above the top of dies.

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* The yield in this case was from about 780 tons of the quartz, or a two-weeks run.

At Rocky Bar Mill, 16 stamps, weighing 1,025 pounds, or an average of 1,000 pounds, each.

Jefferson Mill, Brown's Valley, 12 stamps, four in each battery; 750 pounds each stamp; not lifted high but run fast, (72 to 75 drops per minute,) the quartz being soft. Blankets and a long sluice below them. No. 4 screen; four inches from top of die to discharge.

Sierra Buttes Mills, near Downieville, two mills, 12 stamps each; four stamps in each battery; round stems and heads; weight 600 pounds in upper mill, 640 pounds in lower. Strike 60 to 67 blows per minute, and from nine to twelve inches fall, depending upon the wear of the dies. Delivery five inches to five and a half inches above die. No copper plates in battery. No. 4 screens, 144 holes to the inch, Russia iron. They clean up once in 60 days, and 66 per cent. of the whole yield is obtained in the battery, including the front plate attached to mortar. Blankets were used for some time below battery, but were replaced by amalgamated copper plates, extending for 40 feet below the battery, and having a slope of one in twelve.

Table showing work done by mills on the Mariposas estate, California, during six months ending January 1, 1864.

Mills.	Average No. of stamps.	Working days.	Maximum crushing capacity—Tons per stamp.	No. of tons reduced.	Tons reduced per stamp.		Total of gold per ton.
					Per month.	Per day.	
Benton	60⅛	58.16	1⅛	3,688	10½	$1\frac{1}{15}$	$5 50
Mount Ophir	28	24.22	1¼	798	9½	1⅓	11 03
Green Gulch	40	113.20	1½	6,924	$17\frac{34}{46}$	1½	9 61
Princeton	24	147.19½	1⅞	6,651	46½	1⅚	13 67
Total and average	152⅛	$345\frac{5}{24}\frac{1}{2}$	1½	18,061	20	1¼	10 35

The data of measurement of tons are from estimates by the book-keepers or the mill superintendents, and may not be accurate within 12 per cent.

At the Bigler Mill, Clear Creek district, June, 1866, there were ten stamps; two Hunter's concentrators; one of Hendy's or Prater's concentrators. The order of succession of the fall of stamps was 1, 4, 2, 5, 3. The amalgamation was effected in battery as much as possible. Two amalgamated copper plates were used, one six inches wide between the top of the dies and the screens, the other six or seven inches wide, placed at the back of the mortar under the feeding chute; both plates being inclined inward so as to be washed clean by the swash of the water.

At the celebrated Gould and Curry Mill, as first arranged for dry crushing, the stamps were placed in batteries of five each, and a belt 32 inches wide drove two batteries, (or ten stamps.)

As appropriate to this part of the report I insert interesting details concerning the Mettacom Mill stamp batteries at Austin, Nevada. These particulars were obtained by Mr. Raymond, and I extract them from his chapter upon metallurgical processes:

> The weight of the stamps is nearly 900 pounds each. There is not so much difference of opinion now as formerly among good mill-men as to the proper weight for stamps. As the amount of horse-power (and hence of fuel) required to run a battery depends directly upon this weight, it has been necessary to find out by experience whether heavy blows do as much work in proportion as lighter ones, and where the proper medium lies. The question has quite as much to do with the discharge as with the crushing. The blow of the stamp not only pulverizes the rock, but drives it outward through the screens. In dry-stamping this is the only force which effects the discharge. Hence the weight of the stamp should not be so great as to necessitate slow running. Probably 750 to 800 pounds is the best weight for general use; though if all mills were run as skillfully as the Mettacom, even 900 pounds would not be too heavy.
>
> The stems are 3⅛ inches in diameter. The usual size is 2⅞, and these stems are, therefore, nearly 20 per cent. stronger and heavier than ordinary; the proportion being as the squares of the diameters. The advantage of putting a larger proportion of the total weight into the stem is the diminished vibration from the blow on the tappet. The stems should always be fitted as closely as possible to the guides; but light stems spring or bend, and wear the guide in rising. There is no wear of this kind in falling, so long as the stem is true. The stems are set 8½ inches apart, the bosses and shoes work within about two inches of each other, and the distance between the tappets is about three-fourths of an inch. The whole length of each battery-mortar is therefore about 5 feet 6 inches.
>
> The cam-shaft is rigged with single cams. The old fashion of triple cams is now about obsolete; but the usual form is the double cam, which many mill-men still prefer, claiming, that as it gives two drops of the stamp for each revolution, it saves friction in gearing, and enables the battery to be run at high speeds without running the engine as fast. These and other arguments for the double cam only prove that it suits the machinery which has been calculated for it. As a matter of fact, however, I have never seen double-cam batteries equal the single cams in speed; and I think Mr. Howell is right in claiming the advantage for single cams, that the shoulder can be brought directly under the tappet, so as to prevent catching. With the ordinary double cam, the shaft must be set further back from the stems, and the cams are easily caught and broken.
>
> This subject is directly related to the speed of the battery. The Mettacom mill has vindicated triumphantly the wisdom of its peculiar features by the most extraordinary running on record. For months together the batteries have been kept at from 98 to 100 drops per minute, rising to 102, or even 105, and never falling below 94; yet there has never been a cam broken in the mill. The Manhattan, an excellent mill, with double cams and stamps weighing only 750 pounds, cannot safely run on the same ore at higher speed than 85 to the minute, and Mr. Curtis, the able superintendent, with the performances of the Mettacom before his eyes, naturally declares himself in favor of the single cam, which would enable him to run his batteries up to 110 per minute. The Mettacom stamps fall 10 inches. The original drop was 9½ inches; but it was increased to ease the cams and give less jar. The rebound of the stamps amounts sometimes to 1½ inches. Strange to say, the high speed maintained has not caused excessive necessity of repairs. On the contrary, the battery has stood the strain better than any other within my knowledge. Even the shoes and dies, which were not supposed to be unusually good, being bought for ordinary hard iron, lasted for five months of continuous running without being replaced. This fact cannot be adequately explained. Probably that particular set was a lucky cast. Ordinarily, it would have worn out in about six weeks; but I do not doubt that the heavy charges put through the batteries at high speed protected the shoes and dies from pounding on one another, which they are quite likely to do in ordinary mills, especially when the feeder is careless. A mill running at 100 to the minute keeps the feeder busy; and he does not wait for a stamp to thunder out, by pounding on its anvil, that it has finished its last mouthful and wants another.
>
> A fact not to be overlooked in this connection is the great solidity of the battery frame and foundations. Nine-tenths of the stamp-mills ordinarily erected would rack themselves to pieces if run as the Mettacom has been, without breaking so much as a bolt.
>
> The gain in quantity of ore crushed is more than proportionate to the increase of speed. As I have remarked, this quantity depends, in dry-crushing especially, on the discharge. I shall speak of that presently, as it regards the arrangement of screens; but I now refer to the frequency of the drops which supply the direct impulse and the air shock, by which the dry "pulp" is driven through the screens. Mr. Howell found by experiment that with 60 drops per minute he could put through in twenty-four hours only about 4½ tons; 90 drops gave a little over 10 tons; and 102 drops more than

15½ *tons*. If we assume that the increase in consumption of fuel would be the same as that in the power generated by the falling stamps per minute, we shall have—

No. of drops per minute.	Horse-power, per stamp.	Increase of power.	Yield.	Increase of yield.
60	1.36	....	4½	....
90	2.04	50 per cent..	10	122 per cent.
102	2.22	10 per cent..	15½	55 per cent.

The increase of speed from 60 to 102, or 70 per cent., increased the yield from 4½ to 15½, or 244 per cent. To this should be added the gain in wages, interest on capital, &c., secured by rapid running. This comparison does not fairly apply to wet-crushing, though I am satisfied that in that process also high speeds are the best. But the difference is not so startling. Most wet-crushing mills come pretty near the average of ½ tons crushed in twenty-four hours per horse-power developed by each stamp. But the above table shows a variation from 0.33 tons at 60 to 0.70 at 102. The performance of the Manhattan mill is about 0.45 ton crushed in twenty-four hours per horse-power developed by each stamp; and this is a fair, perhaps a high, average for such mills.

When the throat of the battery is open, the pulp will be thrown both ways, and some of it comes back on the feeding-floor. This indicates a fact too often ignored in the construction of mortars, namely, that since the impulse given by the stamp is radial in all directions, the greater the surface of discharge the higher will be the duty performed. The Mettacom batteries are not perfect in this respect. They have only a single front discharge, but this is 18 inches high, instead of 12, as is usual. It is noticed that the fine pulp comes mostly through the upper six inches, and hence, in most batteries, would be thrown back into the mortar until it found exit below. Various forms of mortar with increased discharge have been recommended. The maximum discharge per stamp is attained by Clayton's circular mortar, containing only one stamp. There are also mortars with universal discharge, in which the screens go all the way round, being curved at the ends. The most common are the double dischargers, having screens in front and behind, and the feed over the rear screen. The objection hitherto made to all arrangements involving curved screens is the difficulty of properly stretching and keying them, while in dry-crushing, even a rear screen is found to be inconvenient on account of breakage from coarse ore. Mr. Curtis, of the Manhattan, however, prefers a double discharge, while Mr. Howell cares more for end-dischargers. The Mettacom end-stamps are hung with three-eighths of an inch more fall than the others, and still do less work. The order in which the stamps fall varies in different mills, and for wet and dry crushing. The two extremes to be avoided are a simultaneous drop of all the stamps, which would rack the frame, strain the engine, destroy the continuity of discharge, and probably break the screens; and a drop in regular succession, (1, 2, 3, 4, 5,) which would shove the ore to one end of the mortar, and give the stamps at one end too much, and at the other end too little, to do. Some mill-men prefer to arrange the succession so that no stamp shall immediately follow its next neighbor. The orders 1, 4, 2, 5, 3; 1, 3, 5, 2, 4; 4, 2, 5, 1, 3, would satisfy this condition. Others prefer dropping the two-end stamps first, as 1, 5, 2, 4, 3, or 1, 5, 4, 2, 3. The wave of discharge or splash of the water through the screens in wet-crushing is to be taken into consideration. In dry-crushing, the objects to be secured are an equal distribution of ore under the stamps, giving an equal work per stamp, and a maximum discharge of pulp through the screens. The latter seems to be best secured by letting the middle stamp drop last. The outer stamps should then have slightly longer cams, to increase their fall. It will be found that the central stamps take and distribute nearly all the feed. Much depends on the skill and fidelity of the feeder, in both kinds of crushing. Hence the automatic self-feeding batteries used in Cornwall have found little favor in this country. They do not "humor" the stamps; and the difference in regularity of running and in duty performed is more than equivalent to the wages of a good feeder.

The screens of this mill are No. 40 brass wire, (1,600 meshes to the square inch,) which is preferred for dry-crushing to the "Russia-punched." The latter are frequently preferred by mill-men in wet-crushing, on account of alleged greater durability, or in the belief that slits are better adapted to discharge liquid pulp than meshes. I take leave to doubt, however, whether these advantages in any case counterbalance the greater proportional discharge-area offered by wire screens. The Mettacom screens are not vertical, but lean outward about 10 degrees. The pulp generally goes through obliquely, and is as fine as the siftings of a horizontal No. 60 sieve. The angle given has been established as the best for dry-crushing. The gain in amount of discharge, wet or dry, from inclined screens, is universally recognized; but mill-men do not so generally bear in mind that the screen so set should be a little coarser than the fineness required for the pulp, if the best results are to be obtained. Mr. Howell's observation is that stamps ordinarily crush faster than the batteries discharge. He has often put the pulp back through his battery, and found that it took about as long to go through as fresh rock. Running slow gives the fine dust a chance to fall back under the stamps; running fast keeps it constantly in motion, and much of it gets out. I venture to suggest some considerations based upon the foregoing facts, and calculated, I think, to put mill-men upon the right track in increasing the efficiency of dry batteries. It seems to me that dropping 900-pound stamps is a costly way of making currents of air to promote discharge. The object of the mill-man should be to get the highest practicable speed from his stamps, and then to give them such facilities for discharge as that every drop shall do its full work in crushing. The increase of the discharge-area is the first and most obvious means, and a useful auxiliary will, I think, be found in producing a current of air with a fan, which shall suck or drive the fine dust through the sieve. I have seen exhausting fans applied in this way in several mills. There was one in the Sheba, at Star City, Humboldt County, and there were several in the early Austin mills, which were finally condemned. Mill-men are too ready to reject such appliances as soon as they cause a little trouble, whether through faulty construction or careless management. But this point will be found too important to be dismissed so easily. I do not remember ever in my life seeing a stamp mill in which the difficulty of discharge did not really delay the work of crushing. The extreme of excessive discharge, which would do no harm, is carefully avoided, and no one can tell to this day how much the stamp now in use could be made to do by simply improving batteries in this respect. The tide of invention is, it appears to me, running the wrong way. We have innumerable devices to increase the force and efficiency of the blow of the stamp, which is already in advance of the rest of the machinery; while the inventions for improving the mortars and discharges are few, generally imperfect, and regarded with too little favor by those practical mill-men who are alone competent to take hold of them and perfect them.

The screens at this mill last nearly four weeks. When the threads wear thin they begin to shift, and the screens must be removed. They are turned to prolong the wear. The middle of the screen lasts longest. The dies, when new, come up to within about one inch of the lowest portion of the discharge. It is very important to make this interval, called the "height of issue," as small as the screens will bear. The dies used for five months wore away about 1¼ inches, and the introduction of new ones raised the capacity of the battery nearly two tons per day. Much trouble was experienced in keeping the dies in their places in the bottom of the mortar. Finally, 150 pounds of melted lead was poured in, filling the mortar-bed about one inch. This is found to work well. I think that for dry-crushing a single die, filling the whole bed would be better yet. When it wears on one side it can be turned, and so used till it is worn out. This is a German plan, and used successfully in some dry-crushing mills managed by Germans in this country.

The foundation of a battery is the most important part of its construction, and it is the feature most neglected in this country. Few mill-owners like to put so much money "out of sight;" the work of preparing foundations is parsimoniously, ignorantly, or carelessly managed; and the result is that the batteries cannot be run at high speed, and even at low speed they are continually settling, or getting out of line. The great efficiency and stability of the Mettacom mill is due to its carefully-prepared foundation. The mortar-blocks are set on end, upon solid bed-rock. They are nine feet deep. Before placing them the rock was thoroughly smoothed and leveled, and the bottom of each block was planed true. The upper ends of the blocks being (as is the case with all large timbers) sun-cracked, melted sulphur was poured into the cracks. The mortars are set on the blocks and screwed down tight. If screwed (as is frequently the case) directly to the blocks, they will in a few months get loose, and rock and sand will work between, putting the machinery out of plumb and endangering the mortar. To prevent this, two thicknesses of blanket soaked in tar were put between the mortars and the blocks. An arrangement was made by which the settling of the mortars could be measured. It is found that after more than a year of steady running they have sunk uniformly less than one-fourth inch—doubtless due to the compression of the blankets. The freedom from jar in the mill, while the batteries were running at tremendous speed, impressed me as decisive proof of the utility of the arrangements described. There is, however, some vibration in the cam-shaft, which should have been five inches instead of four in diameter. Mr. Howell recommends also heavier bearings. The latter are now eight inches, and should be ten. No Babbitt metal is used in the upper box; it cannot be kept in, and smooth iron is therefore preferred. The battery, running at 98 to 100 per minute, requires about twenty-two horse-power, which is perhaps a little more than half the power employed in the mill, and crushes easily seven tons in twelve hours. This being about the usual duty for twenty-four hours, the rest of the mill, especially the reverberatories for roasting, calculated on that basis, cannot come up to the capacity of the battery; and this great defect in the original plans has never yet been remedied. I have frequently found mills in which the capacity of the roasting or amalgamating apparatus is quite un-ed to that of the batteries. In such cases the extra machinery is practically good nothing, since the capacity of a mill is determined by its least adequate part. The tacom batteries must either run but twelve hours daily, or they must run for a ger period at full capacity, and then stand still until the surplus of the pulp has n roasted.

AUSTRALIAN MACHINERY AND STAMPS.

Next to California and Nevada, Australia is the country in which the atest number of stamp mills have been erected, and where experience re nearly equals our own. It is thus important to glance at the ent and character of Australian mechanical appliances, and, as far as sible, to compare them with similar machines in this country.

The mineral statistics of Victoria for 1868 give some very interesting rticulars concerning the weight and cost of stamp-heads and shanks d lifters, the quantities of quartz crushed per diem, the number of les per square inch in the gratings, the quantity of water used and quantity of quicksilver used and lost. They have reference only to principal gold mines in the several districts; but they will not on t account be less useful.

In the Ballarat mining district the stamp-heads and shanks or lifters ry in weight from 4 hundred weight to 8 hundred weight 2 quar- s, and the cost is from £3 17*s.* 6*d.* to £15 10*s.* The height the stamp- ad falls ranges from 7 to 10 inches. The number of strokes made by mp heads per minute is from 50 to 85. The quantity of quartz ished per head per diem of 24 hours varies from 1 ton to 4 tons. The mber of holes per square inch in the gratings used is from 40 to 200.— he latter number is made use of by the Victoria company at Clunes; grating is fixed at the back of the stamper-box.) The horse-power quired to work each stamp is from 1 to 2. The quantity of water used r stamp-head in crushing varies from 950 gallons to 8,640 gallons per m of 24 hours. The quantity of mercury used in the ripples per mper is from 5 to 75 pounds. The quantity of mercury lost per mp-head per week varies from 1 ounce to 8 ounces.

In the Beechworth mining district the stamp-heads and shanks or ters vary in weight from 4 hundred weight 1 quarter 17 pounds to 7 ndred weight 3 quarters, and the cost from £5 3*s.* 6*d.* to £13 per head. e height the stamp-heads fall varies from 5 inches to 14 inches. e number of strokes made by the stamp-heads per minute is from 40 90. The quantity crushed per head per diem of 14 hours ranges from hundred weight to 4 tons. The number of holes per square inch in e gratings used is from 60 to 140. The horse-power required to work ch stamp-head is from 0.75 to 1.50. The quantity of water used per mp-head in crushing varies from 720 gallons to 11,520 gallons per em of 24 hours. The quantity of mercury used in the ripples per mper is from 5 to 70 pounds. The quantity of mercury lost per mp-head per week varies from ½ ounce to 8 ounces.

In the Sandhurst mining district the stamp-heads and shanks or lifters ry in weight from 5 hundred weight to 8 hundred weight, and the cost m £4 5*s.* to £8 11*s.* The height the stamp-heads fall varies from 6 18 inches. The number of strokes made by stamp-heads per minute from 25 to 75. The quantity of quartz crushed per head per diem of hours ranges from 18 hundred weight to 3 tons 3 quarters. The mber of holes per square inch in the gratings used is from 64 to 140. e horse-power required to work each stamp-head is from 0.66 to 2. e quantity of water used per stamp-head in crushing varies from 4,000 llons to 8,640 gallons per diem of 24 hours. The quantity of mercury ed in the ripples per stamper is from 10 to 40 pounds. The quantity of mercury lost per stamp-head per week varies from ½ ounce to 5½ ounces.

In the Maryborough mining district the stamp-heads and shanks or lifters vary in weight from 4 hundred weight 2 quarters to 8 hundred weight, and the cost from £4 18*s*. 6*d*. to £8 14*s*. 6*d*. The height the stamp-heads fall varies from 6 to 22 inches. The number of strokes made by stamp-heads per minute is from 50 to 75. The quantity of quartz crushed per head per diem of 24 hours ranges from 1 ton to 3 tons. The number of holes per square inch in the gratings used is from 70 to 144. The horse-power required to work each stamp-head is from 0.50 to 2.50. The quantity of water used per stamp-head in crushing varies from 900 to 8,640 gallons per diem of 24 hours. The quantity of mercury used in the ripples per stamper is from 3 to 30 pounds. The quantity of mercury lost per stamp-head per week varies from 1¾ ounces to 8 ounces.

In the Castlemaine mining district the stamp-heads and shanks or lifters vary in weight from 4 hundred weight 2 quarters to 8 hundred weight, and the cost from £4 2*s*. 6*d*. to £21 11*s*. 6*d*. The height the stamp-heads fall varies from 6 to 15 inches. The number of strokes made by stamp-heads per minute is from 35 to 75. The quantity of quartz crushed per head per diem of 24 hours ranges from 1 ton to 3 tons 5 hundred weight. The number of holes per square inch in the gratings used is from 40 to 144. The horse-power required to work each stamp-head is from 0.50 to 2. The quantity of water used per stamp-head in crushing varies from 4,800 to 12,960 gallons per diem of 24 hours. The quantity of mercury used in the ripples per stamp is from 6 to 40 pounds. The quantity of mercury lost per stamp-head per week varies from ¼ ounce to 24 ounces.

In the Ararat mining district the stamp-heads and shanks or lifters vary in weight from 5 hundred to 6 hundred weight 3 quarters, and the cost from £7 to £8 8*s*. The height the stamp-heads fall varies from 7½ to 10 inches. The number of strokes made by stamp-heads per minute is from 60 to 72. The quantity of quartz crushed per head per diem of 24 hours ranges from 1 ton 5 hundred weight to 1 ton 10 hundred weight. The number of holes per square inch in the gratings used is from 90 to 120. The horse-power required to work each stamp-head is 0.75. The quantity of water used per stamp-head in crushing varies from 4,320 gallons to 12,960 gallons per diem of 24 hours. The quantity of mercury used in the ripples per stamp is from 6 to 47 pounds. The quantity of mercury lost per stamp-head per week varies from ½ ounce to 7 ounces.

In the Gipp's Land mining district the stamp-heads and shanks or lifters vary in weight from 6 hundred weight to 7 hundred weight 3 quarters, and the cost from £5 5*s*. to £40. The height of the stamp-heads fall varies from 7 to 10 inches. The number of strokes made by stamp heads per minute is from 60 to 80. The quantity of quartz crushed per head per diem of 24 hours ranges from 1 ton 10 hundred weight to 2 tons 1 hundred weight. The number of holes per square inch in the gratings used is from 70 to 250. The horse-power required to work each stamp-head is from 0.75 to 1.50. The quantity of water used per stamp-head in crushing varies from 1,600 gallons to 25,000 gallons* per diem of 24 hours. The quantity of mercury used in the ripples per stamp is from 10 to 37 pounds. The quantity of mercury lost per stamp-head per week varies from $_5$ ounce to 32 ounces.

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* This is excessive.

It will be interesting, also, for comparison with our own statistics, to note the present number of machines in use in Victoria, Australia, for different mining purposes. The following statement shows, approximately, the number of miners employed, the machinery in use, and its value in the several gold fields in the colony, &c., compiled from the mining surveyor's and register's reports for the quarter ending September, 1869.

The number of miners (including 16,393 Chinese) engaged in alluvial and quartz mining was 68,684.

Machinery for alluvial mining.—Steam engines used in pumping and winding, 422; horse-puddling machines, 1,797; whims, 292; whips or pulleys, 310; sluices, toms, and sluice-boxes, 18,740; hydraulic hose, 13; pumps, 992; water-wheels, 303; quicksilver and compound cradles, 281; stamp-heads crushing cement, 652; boring machines, 21.

In quartz mining.—Steam engines used in winding, pumping, and crushing, 656, with an aggregate of 12,308 horse-power; crushing machines, driven by other power than steam, 67; stamp-heads crushing quartz or other vein stuff, 6,200; winding, washing, pumping, or other machines, moved by water-power, 6; whims, 544; whips or pulleys, 440.

Approximate value of mining plant, £2,219,658. Number of square miles of auriferous ground actually worked upon, 892½. Number of distinct quartz reefs actually proved to be auriferous, 2,808.

Weight and cost of stamps, the quantity of quartz crushed per stamp, &c., at some of the principal gold mines in Australia. Compiled from the "Mineral Statistics of Victoria" for 1867.

Name of district.	Weight of stamps.	Cost of stamps.							Fall.	Blows per minute.	Quantity crushed per stamp in 24 hours.
	Pounds.	£	s.	d.		£	s.	d.	*Inches.*		*Tons.*
Ballarat	400 to 850	3	17	6	to	15	10	0	7 to 10	50 to 85	1.0 to 4.0
Beechworth	442 to 775	5	3	6	to	13	00	0	5 to 14	40 to 90	0.8 to 4.0
Sandhurst	500 to 800	4	5	8	to	8	11	0	6 to 18	25 to 75	0.9 to 3-
Maryborough	450 to 800	4	18	6	to	8	14	6	6 to 22	50 to 75	1.0 to 3.0
Castlemaine	450 to 800	4	2	6	to	21	11	6	6 to 15	35 to 75	1.0 to 3¼
Ararat	500 to 675	7	00	0	to	8	0	0	7½ to 10	60 to 72	1.25 to 1.50
Gipps Land	600 to 750	5	5	0	to	40	00	0	7 to 10	60 to 80	1.50 to 2.05

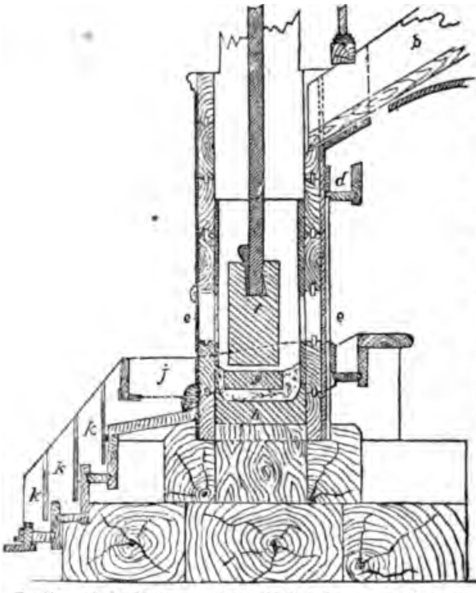
Name of district.	Fineness of grates. (Holes per sq're inch.)	Horse-power expended per stamp.	Gallons of water per stamp.	Quantity of mercury per stamp.	Loss of mercury p'r stamp.
				Pounds.	*Ounces.*
Ballarat	40 to 200	1.00 to 2.00	950 to 8,640	5 to 75	1 to 8
Beechworth	60 to 140	0.75 to 1.50	720 to 11 520	5 to 70	½ to 8
Sandhurst	64 to 140	0.66 to 2.00	4,000 to 8,640	10 to 40	¼ to 5½
Maryborough	70 to 144	0.50 to 2.50	900 to 8,640	3 to 30	1¾ to 8
Castlemaine	40 to 144	0.50 to 2.00	4,800 to 12,960	6 to 40	¼ to 24
Ararat	90 to 120	0.75	4,320 to 12,960	6 to 47	½ to 7
Gipps Land	70 to 250	0.75 to 1.50	1,600 to 25,000*	10 to 37	1.5 to 32

* This excessive.

STAMP-BATTERIES OF PORT PHILLIP.

For the purpose of comparing our methods in California with those in Australia, the following notice of the Port Phillip Company's mines and mill, at Clunes, Australia, is added to the foregoing descriptions. This company mines upon five veins, with an aggregate drivage of 25,590 feet, equal to 4⅞ miles. The depth of the main shaft is 464 feet; length of tramways on the surface for the conveyance of quartz and refuse, 2,500 feet, single-track; engine for hoisting and pumping at the two shafts, about 85 horse-power. The costs of mining and raising the quartz average about 13*s*. per ton. The large masses of quartz are passed through rock breakers, of which there are two. The number of stamps at work is 80; of these 56 weigh about 600 pounds each, including the lifter. They give about 75 blows per minute, require about 1 horse-power per stamp, and crush an average of about 2 tons 4 hundred weight per head per 24 hours. The remaining 24 stamps weigh about 800 pounds each, including the lifter, give 75 blows per minute, require in the aggregate about 30 horse-power, and crush about 4 tons per head per diem. These stamps have the larger portion of the small quartz delivered to them. The quantity of water required to work the stamps efficiently is about eight gallons per head per minute, being 921,600 gallons per diem.

The construction of the batteries and the method of saving the gold in troughs is shown in the accompanying illustration, giving a section through the battery.



Section of the Battery of the Phillip Company, Clunes.

b is the lower end of the self-feeding hopper, with a spring, *c*, below it. Just below this is the water-trough *d*. The stamp-lifter or stem is made largest at the lower end, so as to be wedged into the head *f* by a key at the side, in this respect being very different from the method of attachment in California. The head is cast also in one piece, without a shoe, and is renewed when too much worn. The die *g* is placed loosely in the bottom box or bed *h*. The delivery is through grates upon both sides of the battery, at *e*, *e*. A perforated plate, *j*, serves to retain any coarse particles thrown out, and the stamped material, passing through this plate, falls into the mercury boxes *k*, *k*, *k*, and thence upon a long line of blanket strakes, the extreme upper end of which only is shown in the cut. These strakes are each several inches broad, and there are nine in succession, one below another, with a mercury-box at the lower end, through which the material passes before entering the waste-trough. This mercury-box serves to catch any fine particles of gold that may have passed the blankets and any stray globules of quicksilver from the upper boxes.*

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* The amalgam which slowly accumulates in these boxes has been found to be in a crystalline condition, and, according to Mr. George F. Ulrich, the mineralogist, contains only a small percentage of quicksilver, with a relatively fixed percentage of gold, and forms true crystals, which, under the action of nitric acid, do not become loose and spongy, but take the appearance and lustre of solid gold crystals. They are usually in modified and distorted octahedra, and are sometimes prismatic.

STAMP-MILLS IN BRAZIL.

The stamp-mills, carrying in the aggregate 135 stamps, in use at the Morro Velho mines in Brazil are constructed upon the Cornish pattern, except that each lifter has four iron guides to keep it in position. When new, one of these stamp-heads weighs 230 pounds, and when worn-out only 59 pounds. The average weight may be considered to be 150 pounds, and the duration about four months. The total weight of the stamp, with lifter, shank, &c., is about 640 pounds. The battery-box is made of wood and lined with sheet-iron. The distance between the heads and the sides of the coffer is about three inches. The batteries are self-feeding. The grates are nineteen inches long and nine inches wide, and are made of sheet-copper, pierced with conical holes one-twelfth of an inch in diameter outside and tapering to one-forty-eighth of an inch on the inside. These copper plates are found to be, on the whole, more durable than iron. Further particulars of practical value may be obtained from the following tabular statement, given by Mr. J. Arthur Phillips, from the manuscript notes of Mr. F. Dietzsch, the superintendent of the reduction works:

Number and dimensions of stamp mills at the Morro Velho Mines, Brazil.

Names of stamp mills.	Number of heads.	Blows per minute.	Lift of stamp heads.	Number of cams.	DIMENSION OF STAMP COFFERS.						DIMENSION OF WHEELS.				ORE STAMPED.		
					Length.		Width.		Depth.		Diameter.		Width.		Tons per day.	Tons per head per day.	Pounds per head per day.
					Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.			
Lyon	30	63	10	....	2	2	1	3	2	0	40	6	3	3	36.73	1.22	2,733
Coteswortth	12	61	11	4	2	2	1	1	1	6	31	0	3	0	10.92	1.41	3,158
Susannah	9	65	12	6	2	3	1	3	2	0	19	2	4	4	10.94	1.21	2,710
Herring	24	78	12	...	2	6	1	6	2	0	42	6	6	0	34.56	1.44	3,225
Powles	36	67	12	4	2	2	1	3	1	10	51	0	5	0	66.10	1.83	4,100
Addison	24	73	12	4	2	2	1	3	1	10	42	0	6	0	35.54	1.48	3,315

The product of stamping issuing from the grates in front is diluted with clean water as it runs, and is conducted over inclined tables or strakes about eighteen inches wide and from twenty-seven to thirty-five feet in length, with a fall of one inch per foot. Bullocks' hides, tanned with the hair on, are spread over the first sixteen feet of these strakes, and baize cloths are placed below, followed again by another series of overlapping skins. These skins and strips of baize are washed at regular intervals in separate tanks. The deposit on the first three skins is known as head-sand, and amounts to 0.42 of a cubic foot per ton of ore stamped. This sand goes to the amalgamating house. The "middle sand," from skins Nos. 4 and 5, contains some six ounces of gold per ton, and is further enriched by being washed over another system of strakes. The products below the fifth skin are known as "tail-sand," and are subjected to further concentration. "Mr. Dietzsch remarks that straking may, on the whole, be considered a cheap, simple, and economical process, by which 67 per cent. of the gold originally present in the ore is obtained in a highly concentrated state, while the 33 per cent. which escapes is in two distinct forms—first, light free gold; second, gold inclosed in the coarser particles of pyrites."

The dimensions and products of the strakes are given in the annexed table:

Dimensions and products of strakes at the Morro Velho Mines, Brazil.

Names of stamp mills.	Number of heads.	Number of strakes.	Length of strakes.		Width of strakes.		Area of strakes.	Square feet per ton of ore stamped.	Tons of ore passing per 24 hours.	Number of skins on strakes.	Number of baizes on strakes.	Quantity of head-sand per day.
			Ft.	*In.*	*Ft.*	*In.*	*Sq. ft.*					
Lyon	30	36	31	10	1	6	1,719	46.83	36.73	288	210	20.00
Cotesworth	12	13	30	6	1	4½	545	32.21	16.92	104	65	5.50
Susannah	9	8	27	0	1	6	324	29.61	10.94	48	48	2.75
Herring	24	29	35	0	1	6	1,232	35.64	34.56	228	174	18.00
Powles	36	42	33	7	1	3½	1,821	27.55	66.10	336	252	28.47
Addison	24	30	31	10	1	5	1,352	38.04	35,54	240	170	17.00
Total	135	158	....		....		6,993	....	200.79	1,244	919	91.72

THE GERMAN STAMP BATTERIES.

In Germany the round stem revolving stamp has not been introduced. Square stems of timber with square heads are the most common, and the cams are usually short projections from a large cylindrical wooden shaft, lifting the stamp by catching under a projecting tongue. The stamp stems are also made of rectangular iron rods, either single or bolted together, and secured to the square shank of the stamp-head and shoe (all in one piece) by means of bolts. The head is about six inches square and nine inches high, ranging with the weight desired for the stamp.

The mortar-box or coffer is made of planks lined with sheet-iron,* and the bed usually consists of stamped quartz pounded in by the stamps or solid stone, or, better, of heavy cast-iron dies or anvils as long as the bottom of the mortar. These dies are simply rectangular masses with plane surfaces, and the upper die is four inches thick. As a very firm and even foundation for it is necessary, it is found best to place it on another mass of similar form but heavier, from six inches to twelve inches high. In the cross-sections of batteries given beyond, these iron dies are seen at *g* and *g*. The lower of the two masses rests directly upon the ends of blocks of wood or upon heavy timber, which is supported upon cross-sills still lower, and these in turn upon masonry. When it is intended that the battery shall stand independently of the frame of the building, the foundations are carried to a greater depth. The upper iron block or die of course is subjected to rapid wearing, and it is generally allowed to wear off for one and a half-inch before it is turned over. When it has been worn out to this extent on both sides it is reduced to a plate only an inch thick, and is then broken up. These dies do not fit tightly between the sides of the mortar; a little space is left, which is filled by wedges, and when these are removed the die can be easily turned. For convenience of handling they are made with short projections at the ends.

Iron is beginning to be used to some extent for battery frames and mortars, and Rittinger gives figures of end-posts, intended to receive wooden sides, being cast with vertical grooves for the purpose. Into these grooves the planks designed to form the mortar boxes can be fitted and then secured by drawing up the posts by bolts. The posts rise high enough to receive cross-pieces above, and at the base are expanded into three horizontal branches or feet so as to form a firm base by which the whole is bolted down to a massive foundation of masonry. It does not appear that the California system of anchoring the battery frame to masonry or heavy cross-sills is in use abroad. On the other hand, the timber frames of stamp batteries are frequently united with the framework of the building in which they are placed.

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* The reader, inclined to wonder that batteries so ingenious and well-constructed in some other respects, still retain the wooden mortar, should remember that they are not built for crushing gold ore, and hence perfectly tight mortars are not required.

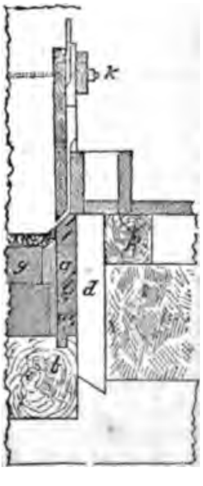
In the Revue de l'Exposition 4, page 154, mention is made of stamps constructed entirely of metal at Silberau near Ems, and shown by a working model at Kalk. A figure is also given which represents the stem as round and very light, with a screw-thread cut at the top, upon which the iron tappet is screwed like a nut. This method of attaching the tappets was formerly used in California, but it has been abandoned since the introduction of the "gib-tappet" already described.

OVERFLOW BATTERIES.

The overflow or float battery is the simplest form, and is made with numerous modifications intended to insure the best working results. The overflow may be along the whole front of the mortar-box, or at the ends alone, or at the front and ends; but in practice it is generally confined to the front and to two forms of the float battery: 1. That with the unobstructed overflow, the stamped stuff with the water being carried over the edge of the front wall of the mortar; 2. The partition overflow battery, or *Schubersatz*, in which the overflow is obstructed by a partition descending below the surface of the water in the battery, leaving only a narrow slit or space through which the water and materials can flow out.

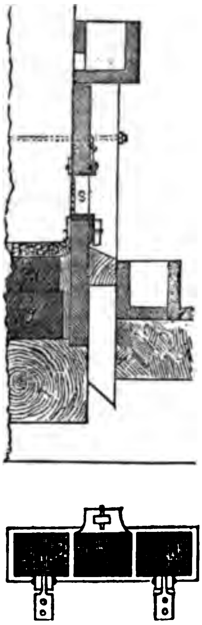
Batteries of the first form are made with the overflow from 8 to 15 or 18 inches above the bed, according to the fineness of the stuff required, being from 15 inches to 18 inches when particles of one millimetre in diameter are to be produced. For coarser materials, the height may be diminished to 8 inches, and with this height particles five millimetres in diameter will be delivered. The amount of water required for each stamp varies from four-tenths to eight-tenths of a cubic foot per minute. The swash in an open overflow battery will always carry over more or less of the coarse uncrushed fragments, particularly when the height of the discharge is not great, and it is to obviate this difficulty that the partition float battery has been devised.

In this form of battery the discharge takes place through a long and narrow slit, opening in the mortar at a height of four or five inches above the die, and extending outward and upward to the height which would be required for the discharge edge of an open battery. In the annexed figure, which is a section of the front part of a mortar made of wood, this opening may be seen, extending from just above the surface of the broken ore upon *g* upward to the top of the trough. The wall or partition between this narrow space and the interior of the mortar-box is so fitted in that it can be taken out in order to clean the mortar or remove any obstruction that may have lodged in the opening. If the slit is placed too low in the mortar it is liable to be choked. It should not be less than three inches above the die. It is also important not to have the opening too large, as the velocity of the upward flow of water would then be diminished, and would not be sufficient to carry out



the pulp without the use of a much greater quantity of water than is desirable. It is evident that the quantity and fineness of the stuff delivered by this outward flow of water may be regulated by the supply admitted to the battery. The consumption of water for such stamp, with a three-quarter inch slit, varies from two to three-tenths of a cubic foot per minute.

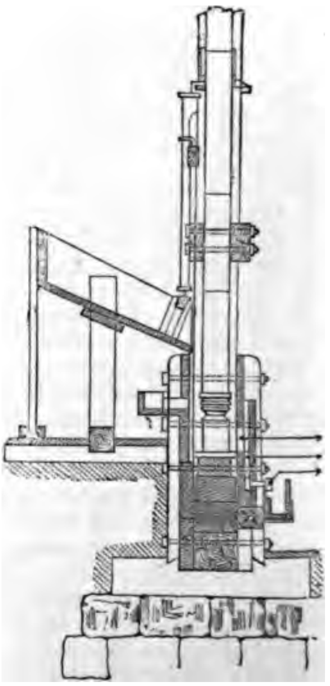
GERMAN SCREEN BATTERIES.



In the German screen batteries, the screens are placed in the front, generally at a height of six inches above the die, and rarely at three inches when the quantity of water is great.

The figure is a section of the front of such a battery, showing a method of holding the screen S in place by means of a frame. An opening of the length and breadth of the screen, is cut out of the planking of the front of the mortar-box, and a rectangular iron frame is bolted or screwed on to the inside of the box and projects so as to form a shoulder three-quarters of an inch wide all around the opening. The screen being placed in the opening fits against this projection, and is then held tightly by another frame or follower which is movable and swings from hinges above, and is provided on its lower edge with a projecting ear that fits over a staple through which a wedge is driven to hold the frame securely in its place. With this construction it is practicable to place the trough for supplying water in the front instead of at the back as is usual. In this figure the two anvils or blocks of cast-iron are seen at *g* and *g'*.

The impurities of water flowing through the battery, especially floating objects such as sticks, grass, and the like, tend to gradually close up the meshes or holes of the screens, and thus, by preventing the free exit of the crushed stuff, to diminish the product. In order to prevent this, the form known as the *Stausatz*, or stay-battery, has been devised by Rittinger. It consists essentially in backing water up against the front of the screen, so that both faces are kept washed, and the impurities dislodged by the swash, and not held fast in the holes by the constant pressure of the outward current. This is accomplished by putting on an outer water-box or a plate in front, thus holding the water against the face of the grate. The discharge is at the bottom, through one hole or escape-pipe, made conical in its form, so that by slipping on caps of different sizes the aperture may be varied at will, in order to increase or diminish the flow.



Rittinger's Stamp Battery.

he construction of this battery may be understood from the engrav- which is a section through the center of the battery, showing the ips; the bed, with the two iron dies; the water-box in front; the pe-pipe; and in the rear of the battery the chute for automatic ing, which is a common attachment to the German batteries, and lly delivers the ore to the central stamp.

ittinger* has compared the fineness of the product of the two kinds attery, the Stausatz and the Schubersatz, each furnished with ens punched with holes one millimetre in diameter, and finds that Stausatz or stay-battery gives much less slime than the partition -battery. The following are the figures which he gives in support is statement:

Size of particles. *mil.*	Stausatz, per cent.	Schubersatz, per cent.
0.00071	12	2
0.00051	31	28
0.00035	10	10
0.00025	47	60
	100	100

CHAPTER LXXX.

PANS FOR GRINDING AND AMALGAMATING.

very period of excitement and enthusiasm in mining brings with it eat demand for machinery, and stimulates the production of numer- contrivances for extracting the precious metals. At such times it t unusual that men who have had little or no experience in mining, gn and manufacture for sale machines for crushing, grinding, and entrating, and other men of even less experience buy the machines pay transportation upon them to the real or fancied mine. Such hines, although they may be well constructed and perhaps adapted me special condition of things when made, are rarely found to an- r the intended purpose in practice, and are soon thrown out of the , and ranged along the outer wall as relics. These are the machines hich it has been most aptly said, "They are more advertised than l."

ut each futile effort has accomplished one useful result. It has in- cted by experience, and in more than one case has led gradually to perfection of machines, and apparatus especially adapted to the liar necessities of our mining regions.

THE GREAT NUMBER AND VARIETY OF PANS.

he same necessities which led the metallurgists of the Pacific t to adopt iron mortar batteries led them also to the construction of pans for grinding and amalgamating. The old methods of grinding rrastras or by Chilian mills were cumbrous and slow, difficult to n up rapidly, and wasteful of quicksilver and amalgam. The man- ture of pans also received a great impulse from the fact that the ore he Comstock lode was peculiarly well adapted to working in such vessels. Its chemical composition is such that the iron of the pans assists its decomposition. It not only contains free gold and silver, but a large part of the undecomposed compounds of silver consists of the sulphide, which, under proper treatment, is readily decomposed in the pan, the particles of iron worn off in the grinding facilitating the process. The ease with which this ore could be reduced in pans, naturally led the mill-men and miners to believe that the same apparatus and processes would work equally well upon other ores—an error which experience soon rectified.

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* Lehrbuch der Aufbereitungskunde, 1867, p. 75.

The demand for pans for Washoe and for new mills in the new districts caused them to be made in great numbers and in a great variety of forms, each inventor urging some peculiar excellence attaching to his mode of construction. Some were made for grinding; some for grinding and separating; others were intended simply for amalgamating. This diversity was still further increased by the modifications in the form of each made from time to time by the inventors, so that when we look back for a few years we find a long list of the different forms of pans and amalgamators which have been made for the use of miners and metallurgists, and all of which have been more or less used for the purposes intended. Among these may be cited Knox's, Wheeler's, Varney's, and Hepburn's pans; Wheeler and Randall's tractory conoidal, or excelsior grinder and amalgamator; Wheeler's amalgamator; Excelsior continuous grinder and amalgamator; Belden's pan; Belden's separator; Wheeler and Randall's conoidal separator; Bartola pan; Gaston's pan; Baux and Guiod's grinder and amalgamator; Moore's grinder; Hinkle and Capp's centrifugal ore-grinder; Farrand's amalgamator and separator; Coleman's little giant amalgamator. To these may be added some of the principal pans now in use, as well as some of those mentioned. These pans, which will be described last, are Patton's, Wheeler's, with wooden rim, Booth & Company's, Stevenson's and Horn's.

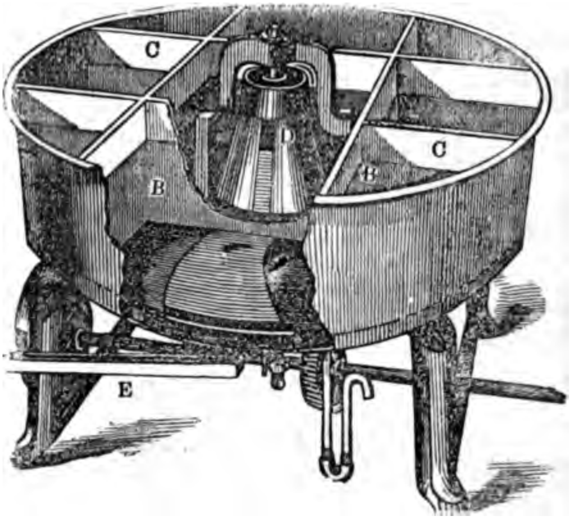
The attempt will not be made to describe all of these pans and amalgamators; they are all similar in their action. The grinding in all is effected between two opposing plates of iron, and the chief differences between them consist in the modification of the form of these plates and the extent of their surface. They all combine the qualities of a mill with the capacity to hold a certain amount of ore-pulp, for it is not simply grinding that is required; the operation of amalgamation and chemical reduction of the ores is connected with it. Inasmuch as the constant grinding would soon cut through the thin bottoms of the pans if unprotected, and destroy the mullers, false bottoms or dies are cast for the pans, and face-plates (shoes) of hard white iron for the mullers. These are so made as to be easily taken out, and are renewed when worn out.

In general, the pans are not intended to receive and grind coarse materials, though in some of them ore as large as kernels of corn, or even larger, can be ground to a fine powder without much injury to the pan. In practice it is the battery-pulp and sand which are fed, and this is generally done in charges, (or "batches,") the weight of which depends upon the capacity of the pan. They are first ground, and then, with the addition of quicksilver, and at a lower rate of speed, the amalgamation is effected. The charge is then drawn off into a larger pan, fitted with stirrers, called the separator. In this the pulp is much diluted with water, and the quicksilver and amalgam fall to the bottom and are collected. The principal pans and amalgamators may be grouped in two chief divisions: 1. Those with flat bottoms. 2. Those with curved or conoidal bottoms.

KNOX'S PAN.

One of the oldest and simplest forms of the iron grinding and amalgamating pans is that invented and introduced by Mr. Israel W. Knox, of California, soon after the opening of the mines upon the Comstock lode, and since then extensively used in the reduction mills of the Pacific coast.

This pan is usually made about four feet in diameter for working gold ores, and fourteen inches deep. The pan used for working silver ores is five feet in diameter. The construction may be seen by reference to the figure. The bottom is flat, but rises in the centre in the form of a truncated cone, as high as the rim of the pan. This cone is hollow, and gives room for the bearings of a vertical shaft, geared by bevel spur-wheels to a horizontal shaft under the pan, and intended to give motion to the mullers. These mullers are four in number, thin and flat, and are bolted to an annular collar or centre-piece, surrounding the bottom of the cone, and upon which two upright bars or standards are cast, which lock into the ends of the yoke on the top of the vertical shaft. C C is a board frame, fitting the inside of the pan, and reaching downward to within half an inch of the mullers. B B are amalgamated copper plates, fastened to the board frame for the purpose of catching the lighter particles of gold as they float through the pulp when stirred by the rotation of the mullers. The discharge of this pan is central, through an opening in the cone near the top, D, and controlled by a gate, at the pleasure of the operator. The pulp and waste discharged are received in a sluice, E, below.



Knox's Improved Amalgamator and Separator.

The bottom of this pan was at first made single; but it was subsequently improved by Mr. Palmer by making it double, thus giving a space or chamber into which steam may be introduced for the purpose of heating the charge, when it is required to promote the decomposition and amalgamation of the ore. This chamber is seen in the figure. The steam is introduced by a pipe. The steam-chamber is formed by means of a false bottom, cast with two concentric annular projections which fit upon the bottom of the pan.

The usual charge of the four-foot pan is 250 to 300 pounds of dry ore, and of the five-foot pan 400 to 500 pounds. The former are most used for amalgamating and separating, and the latter for grinding and amalgamating.

The muller, being made to revolve about twelve times in a minute, carries the pulp and causes it to "swash" against the amalgamated plates, thereby collecting most of the fine float gold and quicksilver. The discharge being near the surface of the liquid pulp, and where there is the least motion, there is little chance of the loss of quicksilver or the precious metals.

It is common to work the pans continuously, but much better results are obtained, at least in some cases, by crushing the ore dry and fine, and then introducing it into the pan by charges, and working until amalgamation is complete.

The simplicity, cheapness, and convenience of this pan, the ease with which it can be charged and cleaned up, together with its effectiveness, have caused it to be largely used, even to this time, by the mill-men of the Pacific slope.

KNOX'S EUREKA GRINDER.

Mr. Knox also makes a pan specially designed for grinding. The central cone is made larger, so that it fills nearly one-half of the diameter of the pan, the object being to have as little difference of velocity between the inner and outer edges of the grinding surface of the muller as possible. The grinding is thus confined as much as possible to the bottom of the annular trough between the sides of the pan and the cone in the center. A die, or false bottom, is placed in this annular trough, and can be renewed when worn out. Its upper surface is grooved, and the shoes, four in number, are made pointed, and curved in such a way that, as they revolve over the grooves of the die, they cut or grind with a shearing action, thus moving with more ease and regularity, and, as is claimed, grinding the pulp with more rapidity.

VARNEY'S PAN.

This is also one of the most extensively used pans. The grinding surface at the bottom is formed by four dies of hard white iron, and there are twelve shoes riveted or bolted to the mullers. The dies have radial grooves which facilitate the grinding. The charge is from 600 to 800 pounds of ore. It will take coarse stuff that passes screens with four meshes to the inch. Curved plates, or guides, serve to throw the pulp back from the circumference to the center, so as to again pass under the mullers. The muller should make about eighty revolutions a minute, and requires to drive it from three to five horse-power. The shoes and dies will last from forty to sixty days, each of twenty-four hours working.

The invention of Varney is declared in his patent to consist "in the employment or use of a rotary and stationary muller placed within a suitable pan or tub, provided with a cover, and arranged in such a manner that when the device is in operation the ore will pass in a current or stream outward from the center, and between the mullers to the circumference of the same, and thence inward over the upper and rotating muller to the center of the same, and down through said muller between it and the stationary one, to be again thrown to the periphery of the mullers, thereby causing all the particles of the ore to be brought in contact with the quicksilver in the pan or tub, or with the amalgamated plates to be attached to the muller or mullers."

"This invention also consists in the employment or use of curved or spiral scrapers placed within the pan or tub, and arranged relatively with the upper surface of the rotating muller in such a manner as to insure the passage or movement of all heavy substances in the pulp, thereby preventing the same from lodging on the rotary muller."

MOORE'S QUARTZ GRINDER AND AMALGAMATOR.

This pan has a flat bottom, with an acute cone rising in the center. The muller is made to fit both the bottom and the cone, and is provided with shoes opposing crushing plates on the cone, so that the stuff which is fed by means of an annular hopper at the top of the muller will be subjected to crushing or coarse grinding before it reaches the broad and horizontal grinding surface at the bottom. This pan is usually made six feet in diameter and with vertical sides. The pulp entering in this manner at the center must traverse the whole distance to the outer margin of the solid muller before it can ascend above it into the body of the pan.

WHEELER AND RANDALL'S EXCELSIOR GRINDER AND AMALGAMATOR.

The excelsior grinder and amalgamator of Wheeler & Randall is a deep pan, with a large conoidal center rising as high as the rim and molded so that its vertical section forms a tractory curve from the top to the bottom. This forms the grinding surface, to which the muller is fitted and revolved by locking on a vertical shaft, to which motion is given by bevel gearing below the pan. Four sizes are made; largest, 4½ feet in diameter, weight 5,000 pounds; medium, 4 feet in diameter, weight 4,000 pounds; prospecting size, 2 feet in diameter, 900 pounds; assayer's pan, 1 foot in diameter.

The advantages claimed by the inventors for this construction are:

1. That perfect uniformity of wear in the grinding surface is obtained by the use of the curved face.
2. That it reduces the ore far more rapidly and at a less expense of power than any other pan of practical form and proportion.
3. That it possesses superior amalgamating qualities.
4. That its mechanical construction as to simplicity, weight, strength, convenience of working, cleaning up, and cheapness, is unequaled by any other grinder and amalgamator.

This is probably claiming too much for this form of pan. That it is an excellent grinder is well known to the writer from observation and personal experience. For amalgamation there are other forms of the pan that are quite as effective. The large space occupied by the cone and muller renders it necessary to make the pan very deep, in order to hold even moderate charges, and it is not as conveniently cleaned as a pan of less depth.

Wheeler's amalgamator has much more space around the muller. The cone is smaller, and the muller broader and flatter. The construction is otherwise nearly the same as in the excelsior grinder, and both are provided with a lever, connected with a hand-wheel, working on a screw at the side, by which the height of the muller above the bottom may be easily varied so as to regulate the rate of grinding.

Both of these pans are also made in sections, so that they can be taken apart and transported on animals into places difficult of access.

Another modification is the continuously working pan, made substantially like the preceding, but with a cover bolted on to the rim and rising to the top of the muller. The pulp, being fed in at one side, escapes at the top, around the narrow neck of the muller, and flows off through a covered chute or rectangular tube, cast upon the cover.

BELDEN'S GRINDING AND AMALGAMATING PAN.

This is an effective and convenient form, and has the advantage of giving plenty of space for the pulp. The grinding surfaces are confined to an annular curved zone, between the sides and a slim central cone. It thus differs materially from the excelsior grinder and amalgamator, in which much of the grinding is effected upon the sides of the cone. Lightness, simplicity, ease of cleaning up, superior grinding and amalgamating qualities, have been aimed at in this machine.

HEPBURN AND PETERSON'S PAN.

This is a deep pan, with the bottom in the form of a section of an inverted cone; the reverse of the pans with conical centers, rising to the height of the rim. In this pan the inclination is towards the center, at an angle of about 28 degrees from the horizontal. A vertical cylinder or tube rises from the bottom in the center, through which the shaft for driving the muller is carried. It is fitted with four dies, which cover the grinding surface of the bottom, and the muller is fitted with fluted shoes, shaped to conform to the curvature of the dies. The charge for this pan is about 1,000 pounds. In grinding, the pulp is thrown from the center under the shoes, and rises highest upon the outer rim, and then falls over toward the center, to be again carried under the muller.

The new Hepburn pan.—Another pan has been introduced by Mr. Hepburn, in which the grinding is not effected by the rubbing of two opposing rigid plates of iron, but by a number of rolling disks, pressing with their flat sides upon the dies, and rolling by friction upon each other. This pan has been experimented with, and noticed by, Mr. Louis Blanding, a metallurgical engineer of large theoretical and practical experience. He says, in June, 1869:

> Four months ago I became convinced of its great value, after thorough investigation, and have almost daily since that time worked on it silver ores from Nevada, both chloride and sulphuret ores, and gold-bearing quartz from California. The essential difference between it and pans of the ordinary style consists in this: the former acts by a rolling motion, the disks or rollers being loose in the pan, but crushing and pulverizing strongly against the dies by centrifugal force; the latter by a grinding friction of rigid iron surfaces in contact under great weight. This difference of action explains the difference in power required to operate the respective pans; the Hepburn, other things being equal, consuming not more than 40 per cent. of the power ordinarily required, as shown by tests in the Rock Point mill on the Carson River, and other mills. The disks or rollers, rotating on their own axes upon the dies of the muller plate, also serve to reduce the ore at these lines of contact by a cutting and wearing action, the crushing and wearing operation of the revolving circumference of every two of the rollers on each other effectively aiding the reducing action. These rollers have a peculiar action; they operate to crush the coarse ore on the side dies, and pulverize on the muller dies as well as by the action of their rotating sides on each other. The next point worthy of notice is the fact that this pan will take ore through a screen of half an inch mesh, and reduce it as rapidly and finely as the ordinary pan reduces the sands taken from the fifty-screen of a battery. The rollers, being free and not rigidly fixed, adjust themselves to the size of the material fed to the pan. This avoids the necessity of a battery, (dry or wet,) as the ore will be prepared for the pan by a breaker, or a pair of Cornish rollers, which can be furnished at considerable less cost, and for the work accomplished requires much less power. All drying of the ores and the consequent expense and loss of time are also saved by this mode of work. A third point of particular interest is the fact that amalgamation can be effected by proper management in the bottom of the pan, separate and distinct from the pulverization at the same time proceeding in the upper or working part of the pan, in which point it is essentially different from the pan of ordinary form, and whereby the loss of quicksilver, by excessive grinding and consequent flouring, is greatly prevented. The result of practical work, both in silver and gold ores, shows the loss of quicksilver to be not more than one-third to one-half that usually experienced on charges of ore of equal quantity treated equal lengths of time. There are other minor differences that an inspection of the small 50-pound pan, now working, and of the large 4,000-pound pans, now being constructed at the Vulcan Foundry, in this city, will at once suggest. It was at first difficult to perceive the cause of such rapid action on such coarse and hard stuff in a pan running so easily and lightly; but the solution was readily found by a calculation of the surfaces brought into action in a given time, and which it would be out of place

here. Theory and practice seem to concur in this matter, at least, and I can e that the promise of this really original invention will be realized in large

FARRAND'S AMALGAMATOR AND SEPARATOR.

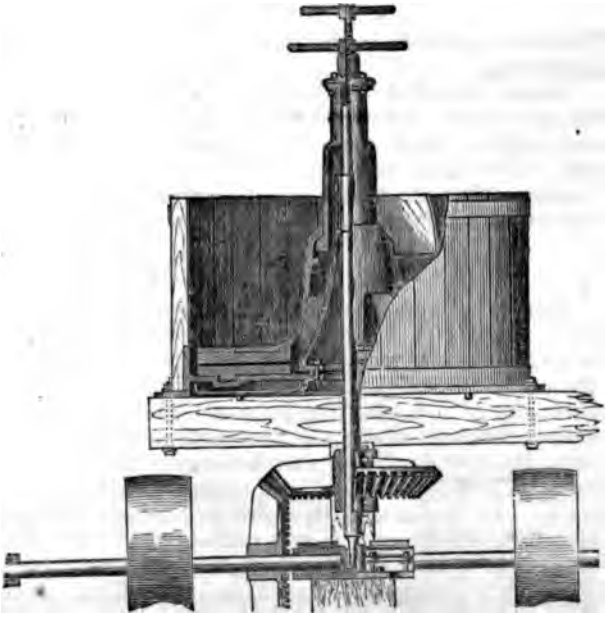
is a machine which attracted some attention in 1864, but was xtensively used. The motion is not rotary, but reciprocating. achine consists of a semi-cylindrical, trough-shaped vessel, the r of which is furnished with movable concave dies, to be replaced vorn out, as in ordinary pans. The mullers are convex, and at- to a substantial shaft, by which they are moved back and for- by crank or eccentric motion. The mullers are held to their by springs of moderate strength, the pressure of which may be regulated. The oscillating motion of the mullers serves to keep lp in a constant state of agitation, thoroughly mixing it, and it under the mullers without resort to any of the various expe- employed in pans where a circular motion is maintained. In g this amalgamator no quicksilver is placed in the pulp until uration is completed. That done, the mullers are raised, so as pletely break contact with the dies, the quicksilver sprinkled e mass, and the machine set in motion again, the mullers simply as stirrers.

PANS NOW MOST IN USE.

experience with the great variety of pans that have been made l at last to the adoption of the more simple forms, in which the g is effected beween horizontal flat surfaces instead of the curved nical bottoms. In the pans now most in use, these flat grinding s form an annular floor around the central cone, through which tical shaft passes. This central cone is no longer used for grind- d is made much smaller than formerly. Wood is now also sub- d for the sides of the pan, as will be seen by the inspection of the d figure of Patton's pan.

TON'S PAN.

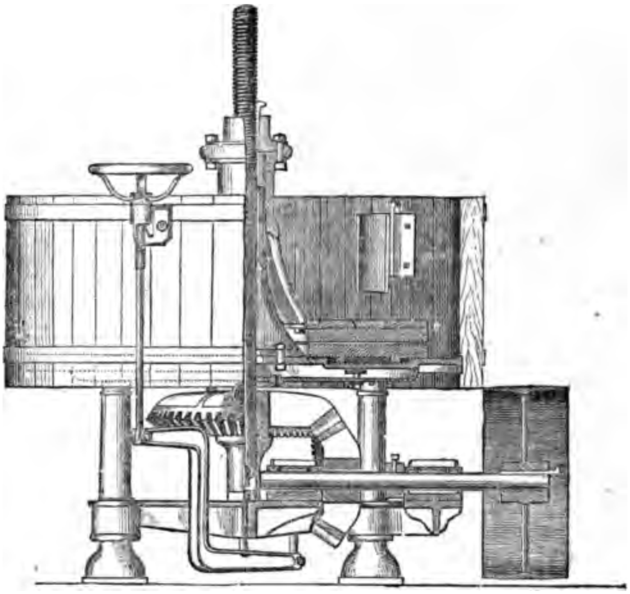
ill be noted the wooden are vertical at the staves d by a strong oop upon an flange or er of the bed- vhich rises in ide of the pan h as the top muller, this as high as is much fric- exposure to kage of quick- The bottom in one piece as a chamber it for the ad- n of steam to he pulp and



Patton's Pan.

promote amalgamation. The pan or tub is five feet in diameter and two feet deep. The motion of the muller is given by bevel-gearing below. The distance between the grinding surfaces is controlled by raising or lowering the muller by means of a screw working in the top of the vertical shaft.

Wheeler's pan, as now made with vertical wood sides, is shown by the next figure.



Wheeler's Pan.

WHEELER'S PAN.

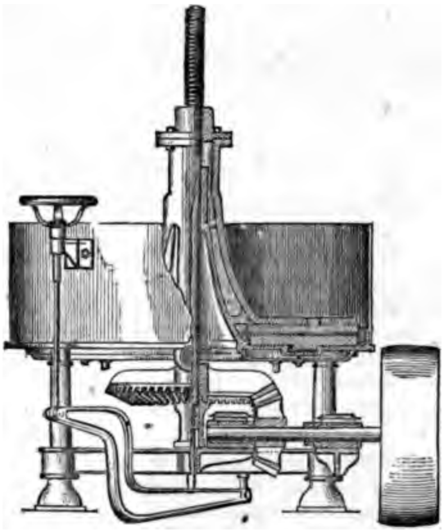
It is five feet in diameter, but not quite so deep as Patton's, and the attachment of the staves to the bottom plate is different. There is also a wider annular space between the dies and muller and the sides. The distance between the muller and the dies is regulated by a screw with a hand-wheel upon the outside of the pan, which, by means of a bent lever at the bottom, raises the vertical shaft and so lifts the muller. This arrangement is the same as used in the older forms of Wheeler's apparatus.

Messrs. Booth & Co. make a similar pan with sheet-iron sides. The annular space between the dies and the sides is not so great, but the cast bottom plate rises higher, and is thus more secure against leakage. The sheet-iron rim or side is not only light, but it has this advantage, that when left dry for a time it will not shrink and crack as the wooden tubs must inevitably do.

COX'S PAN.

This is a large, heavy pan, in which the hard gravel cement of the deep placers is broken by revolving arms. Since the pebbles and boulders of this material are usually barren, while the cement between them carries the gold, it is desirable to relieve the stamp-mills from the necessity of crushing the former. The pan is provided with a grating below, through which the finer and auriferous material falls when freed from the boulders, and can be conveyed to the mill, while the boulders remain in the pan, and are removed as they accumulate, and thrown away. It is claimed that this device effects a great saving in the cost of cement-crushing. It was introduced in 1868, I believe, and I have no reports of actual results, though several machines are said to be in use in Nevada County, California, and elsewhere. It resembles the grinding and amalgamating pans only in name and external form.

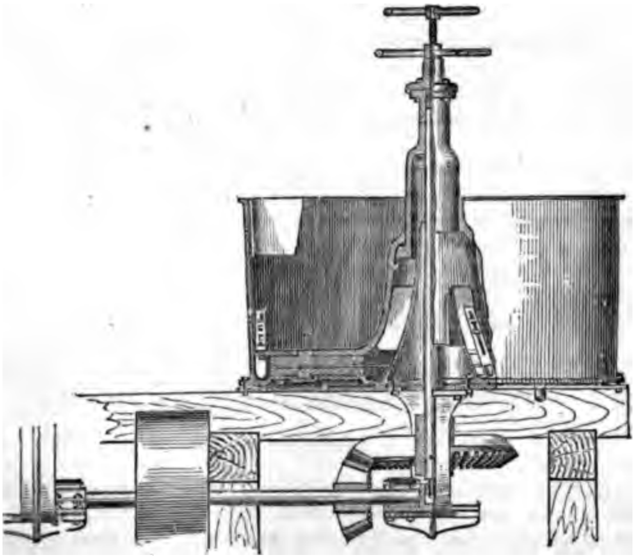
H. J. BOOTH & CO.'S PAN.



Booth & Co.'s Pan.

Horn's pan, as shown by the last figure of this series, is cast in one piece and is slightly flaring. A depressed annular space three inches wide is left around the dies and is traversed, as the muller rotates, by an arm, which extend to the bottom. The muller is raised by a screw at the top similar to that used for Patton's pan.

HORN'S PAN.



Horn's Pan.

This pan, like all the others here figured, is made with a double bottom, thus giving an annular steam-chest for heating the charge.

SECTION V.—SEPARATION AND CONCENTRATION.

CHAPTER LXXXI.

THE CONCENTRATION OF AURIFEROUS ALLUVIUM.

As generally used in mining "concentration" refers to the enrichment by mechanical means of the ores that have been raised from veins. So restricted, it may be said that in the mining regions of the west it is confined chiefly to the separation of gold and sulphurets from quartz. But the grand washing operations of the placer gold miner are properly classed with those of concentration. With the aid of water he sweeps away the earth and gravel, and collects the grains of gold, which, by reason of their greater weight, remain behind.

The simplest and most common implements used for concentration are the miner's pan and the horn-spoon. The pan, so much used in California, not only for prospecting but in cleaning up sluices and mills, is at present stamped out of one piece of the best quality of Russia iron, and is a far better article than was formerly in use. It resembles an ordinary tin milk-pan in form, but its sides are more sloping and it is strengthened by a stout wire in the rim. In the gold region of the Carolinas and Georgia, the pan formerly employed was either the ordinary iron frying pan or a light steel pan, a little deeper, and elliptical in form.

The horn-spoon is a very convenient instrument for washing out samples of crushed vein stuff, or any soft material supposed to contain gold. It has one great advantage over a metallic surface, that it does not become enfilmed with air or grease, so as to prevent the perfect contact of the water on its surface. It is made from the large end of the horn of an ox, cut obliquely, and then scraped down to a suitable thickness. A horn that is black at one end makes the best spoon. Its lightness and durability, as well as many other good qualities, make it a favorite implement with gold prospectors.

The *batea* is another form of washing implement for prospecting and testing. It is a shallow circular plate, made from a single piece of wood, usually by turning in a lathe, and is about twenty inches in diameter and two and a half inches deep at the centre, from which the slope is regular and unbroken to the outer edge. It is much used at the gold mines and washings in Brazil; but in California it is not much known, its use being confined, I believe, to one or two experts who have attained the peculiar skilled manipulation it requires.

The cradle, the tom, and various rockers, are forms of concentrating apparatus familiar to most miners, which need not be here described.

SLUICING.

Sluicing is the simplest form of concentration upon a large scale. It is simply the employment of a current of water upon an inclined plane, which sweeps onward the finer and lighter substances more rapidly than the heavier, and thus effects a separation.

The ordinary board sluice is made of rough pine boards, in sections twelve feet in length, so that they can be fitted one into the other and thus form a continuous trough, from twelve to twenty inches wide and from ten to twelve inches deep. In order that one section may fit into the next, they are made a few inches wider at one end than at the other. The usual grade or inclination is about twelve inches or from ten to eighteen inches, according to the nature of the materials to be washed. Cleats or riffles are placed across the bottom to arrest the flow of the heavier particles, and thus make a favorable point for the lodgment of the gold and quicksilver. In order to protect the bottom from the action of the larger stones and the violence of the current, a set of false riffles is put in. These are usually placed lengthwise of the box, and consist of slats, nailed to cross-bars of wood, so that the whole may be lifted out when the sluice is cleaned up or the bars need repairs. Both bars and sluice-boards wear out rapidly during active washing by the constant attrition of the stones; and when the boxes are no longer fit to be used, or if for any cause they are no longer to be used, they are dried and burned, and the careful washing of the ashes gives a very remunerative return of gold, often enough to buy a new set of sluice boxes.

Some details regarding the construction and working of the larger sluices have already been given in the chapter upon breaking down rock; and it is only necessary here to revert to the fact that the operations of breaking up and crushing, and of washing and concentrating are inseparably connected in placer mining, as well as in the extraction of gold from quartz taken out of veins. There is one form of sluicing which, however, has not yet been considered. It is the under-current sluice, an improvement introduced in California, and the outgrowth of the gigantic sluicing operations in that State.

UNDER-CURRENT SLUICES.

These are designed to separate the current in the main sluices into two portions, permitting the great bulk of the muddy current and coarse materials to pass on, while the heavier and lower portions are allowed to drop through a grating on the bottom of the sluice into shallower and broader sluice boxes, having a lower grade, and receiving a fresh supply of clean water. The design is to distribute the materials over a greater surface than could be given in the main sluice, and thus allow the gold to settle.

These boxes are made of various widths, from three to nine feet, and from twelve to fourteen inches deep. The grade is usually one in twelve. The grating, through which the stuff is admitted, is made of hard cast iron, with openings an inch wide and eight inches long. The stuff flowing in the under-currents is sometimes divided, a part being dropped into a second system of low-grade boxes, or secondaries, with a width of about thirty inches, and a grade of fourteen or fifteen inches to the box. They receive about one-fifteenth of the water in the under-current. The grating is much finer than that in the main sluice, the spaces being only three-eighths of an inch wide and five inches long. They are very useful for catching quicksilver.

CHAPTER LXXXII.

THE CONCENTRATION OF VEIN-STUFF.

As has already been remarked, concentration, in ordinary mining parlance, is confined in California chiefly to the separation of gold and sulphurets from quartz. Quicksilver ores and copper ores have, to a small extent at one or two localities, been subjected to concentration, but with these exceptions very little attention has yet been given there to a subject of great importance to the mining interest. The quantity of sulphurets contained in the quartz veins of California rarely exceeds two per cent., and its separation is not attended with any great difficulty, inasmuch as the difference between the specific gravity of the sulphurets and quartz is so great, that, when agitated in water, the particles of sulphuret first find their way to the bottom and form a layer nearly free from the quartz, which settles in an upper stratum. It is upon this difference in gravity of substances, and their consequent different degrees of velocity in passing through water or air, that the operations of concentration are based.

For example, a sphere of gold eight lines in diameter will fall 100 Prussian inches through water in one second of time, while a sphere of quartz of the same size will fall only about 30 inches in the same time. Thus, a mixture of particles of gold and of particles of quartz could be very easily separated one from the other; and also many other substances could be separated where the difference in the velocity of falling is not so great. But the bulk of particles is also an important element, as will be seen from the inspection of the annexed table, in which the relative velocities with which particles of gold, galena, blende, and quartz of different sizes will fall through water is shown:

Table showing the distance in Prussian inches that spheres of various sizes of different substances will fall through water in one second of time.

Diameter in lines.	Gold. Spec. grav. 19.2.	Galena. Spec. grav. 7.5.	Blende. Spec. grav. 4.	Quartz. Spec. grav. 2.6.
8	100	60.093	40.825	29.814
5.657	84.090	50.532	34.329	25.071
4	70.711	42.492	28.868	21.082
2.828	59.460	35.731	24.275	17.728
2	50	30.046	20.412	14.907
1.414	42.045	25.266	17.165	12.535
1	35.355	21.246	14.434	10.541
0.707	29.730	17.836	12.137	8.864
0.5	25	15.023	10.206	7.454
0.354	21.022	12.633	8.582	6.268
0.25	17.678	10.623	7.217	5.270

Thus, while a sphere of gold eight lines in diameter is falling 100 inches, galena of the same size will fall 60 inches; blende, 40.8 inches; and quartz, 29.8 inches. But while the sphere of gold eight lines in diameter is falling 100 inches, one of two lines in diameter will fall only 50 inches, or half as fast as the sphere of the same substance with four times the diameter. Further, a sphere of gold 0.707 lines in diameter will fall about as fast as one of quartz with a diameter of eight lines, or one of galena two lines in diameter, and so on. It thus becomes evident that the velocity of fall of substances in water depends not only upon their specific gravity, but upon their bulk and gravity combined, and that for a perfect separation of substances according to their gravity, it is essential that the particles should either be of the same size or that the variation must be confined within certain well-defined limits.

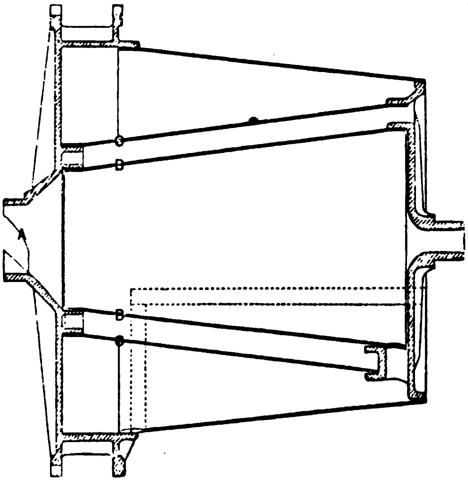
SIZING OF FRAGMENTS—TROMMELS.

From what has already been remarked, it will be seen that a proper sizing of the fragments and particles of crushed ores is an essential prerequisite to successful concentration.

For separating the coarser fragments, such as are suitable for jigging, for example, screens or riddles are used, and for the finer, sieves or perforated plates; while for the separation of the very finest portions resort is had to the action of flowing water.

Screens or riddles are made in a great variety of ways, but are usually flat surfaces of coarse wire or of parallel iron rods, and caused to swing or to jar by rising and falling at one end, so that the stuff may move over the surface by gravity, while the smaller fragments drop through. The product of one riddle may be received upon a second of finer mesh, and the product of the second upon a third, and so on.

For still smaller fragments, sieves in a cylindrical form or trommels are used. They are made to revolve, and are set at an inclination, so that stuff fed into the upper end will gradually descend to the lower, while a portion drops through the mesh and is received either in a suitable box or into an outer concentric cylinder of gauze. This is a form of trommel which was recently exhibited in Paris by Messrs. Huet and Geyler, and which has some novel features. It is not supported upon a shaft passing through from end to end, but is sustained by, and revolves on, trunnions cast upon each of the cast-iron heads or ends, as indicated in the annexed longitudinal section, which represents one of this style of trommels, constructed so as to supply a system of four twin sieves. The crushed stuff is introduced at the hollow trunnion A, and falls upon a grate or perforated iron plate, B, in which the holes are large. The stuff which falls through the plate B, drops upon a second plate, C, perforated with smaller holes, where it is again divided into two sizes, the finer particles dropping through to the outermost plate of all. Each space between the plates has suitable openings at intervals in the cast-iron heads for the discharge of fragments too coarse to fall through the plate below them. This trommel is very compact and will give four sizes of product.



Section of a Distributing Trommel.

In Europe perforated iron or steel plates are now generally used instead of wire-cloth screens, which wear out faster. The Exposition of 1867 was rich in samples of perforated plates of all descriptions and very accurately punched. It is essential to the best working effect that the thickness of the plates should always be less than the diameter of the holes punched in them. The space also between the holes in the finer plates should not be greater than the diameter of the holes—in the medium plates half a diameter, and in the coarser plates one-third of the diameter of the holes. In France perforations less than $0^{m}.002$ in diameter are considered as fine; those between $0^{m}.002$ and $0^{m}.005$ are medium. The fine numbers begin at $0^{m}.0005$. The finely-perforated plates for trommels are generally made of copper, and the other sizes of steel, iron, or zinc.

Rittinger adopts one millimetre in diameter as the unit of holes for sizing ores for concentration, and the progression beyond this is geometric, as 1, 2, 4, 8, 16 millimetres, giving for the volumes of the grains that will pass the holes respectively 1, 8, 64, 512, 4,096 cubic millimetres. He divides each of these sizes into four classes, each with four grades, thus:

	Diameter in millimetres.		In inches, nearly.	
No. 1, (Stufen)	64.0	=	2.51	coarse.
	45.2	=	1.79	middling coarse.
	32.0	=	1.26	middling fine.
	22.6	=	0.89	fine.
No. 2, (Graupen)	16.0	=	0.64	coarse.
	11.3	=	0.45	middling coarse.
	08.0	=	0.319	middling fine.
	05.6	=	0.220	fine.
No. 3, (Gries)	4.0	=	0.160	coarse.
	2.8	=	0.109	middling coarse.
	2.0	=	0.078	middling fine.
	1.4	=	0.055	fine.
No. 4, (Mehl)	1.00	=	0.0400	coarse.
	0.71	=	0.0282	middling coarse.
	0.50	=	0.0200	middling fine.
	0.35	=	0.0137	fine.

BLANKET CONCENTRATION.

Blanket concentration is only a modification of sluicing; a rough surface being substituted for the smooth flat bottom, with riffles and other obstructions, of the sluice. Blankets are in very common use, being at once the simplest and most effective means of arresting the fine particles of gold that escape amalgamation in battery. The blanketing used for this purpose is made specially for it at the woolen mills of the coast, and is very strong, thick, and hairy. It is woven about thirty inches wide, just wide enough to cover the bottom of the strakes or shallow inclined troughs, and to hang over their edges. The troughs are from twelve to sixteen inches wide, with sides from one and a half to three inches high, and are inclined, according to the desired velocity of the current, from five to fifteen degrees. There are usually two or three blanket troughs abreast, receiving the sands as they flow from the battery; but four would be better. While the blankets of one are being washed, the current is turned upon the others, and the greater the surface provided for the flow the less disturbance is caused by the addition of the flow from the first while the blankets are washing.

The upper blankets, where the heaviest of the sands, with the included sulphurets, are deposited, are washed most frequently, sometimes as often as once in every fifteen minutes, but generally once every hour. The second row is taken off only half as often, and the third once in three or four hours; but the time they should be allowed to remain depends upon the amount of stuff which lodges upon them. The rough surface must not be permitted to become completely filled with heavy sands.

There is a very extraordinary example of blanket concentration in the ravines extending from the mills at Virginia City and Gold Hill. The tailings from these mills, estimated to be not less than 600 tons a day, are allowed to run into Gold Cañon and Six-mile Cañon, where they are passed over a great length of blankets, from five to six miles in each cañon. The surveyor general of Nevada gives the following details of blanket washings in Six-mile Cañon for 1866 and 1867:

Number of mills discharging tailings into cañon	12
Probable number of tons worked during the year 1866	100,000
Estimated value of the tailings saved and worked	$72,000
Saving per ton of ore worked	72 cents.
Length of sluices	22,000 feet.
Cost of sluices	$20,000
Estimated value of tailings saved and worked in 1867	$164,000
Saving per ton of ore worked in 1867	$1 64
Average value of tailings saved per ton	$20

USE OF CAST-IRON FOR CONCENTRATING MACHINES.

Numerous concentrating machines, in a great variety of forms, have been made upon the western coast in the last ten years, and many of them, like the pans and amalgamators, have been more advertised than used. They have all been characterized by the use of iron rather than wood, and by their moderate size and compact proportions, suited to the difficulties and expense of transportation. It has been usual in Europe to construct concentrating machines almost wholly of wood to the exclusion of cast iron; but at the late Exposition some French constructors exhibited machines made of iron to the exclusion of wood, and have written a memoir,* setting forth the superiority of iron for such purposes.

They urge that although wooden machines may be made with the greatest accuracy and care, they are no sooner put into place for work than they begin to swell and warp, and in the case of a circular buddle, for example, the whole surface must be made anew. Then, if for any cause the operation of such machines is suspended for a time, the wood dries and shrinks, and when they are again set in operation they are always found to be out of order, and to require extensive repairs. Another important objection to wood is the great bulk of the machines made of it as compared with those made of iron of equal strength. Again, wooden machines do not bear transportation to distant regions, neither are they so durable or so exact and regular in their operation as machines made of iron.

With cast iron the most favorable forms can be given to those parts with which the stuff to be worked comes in contact. All unfavorable angles and joints can be avoided. With iron and cast iron the forms of machines, and of their various parts, recognized in practice as the most favorable to the end in view, can be adopted. The joints being perfectly tight, the loss of earth, water, or ore is prevented. No change of form in the machines, or any injury to them, need be feared by their exposure to either dryness or moisture. If they are required to remain unused for a greater or less time, or if they have to be transported to a great distance, they are not injured. Changes of season or climate do not affect such machines. During the severity of winter, the taps being opened and the tubs and pipes being drained of water, the hardest frosts will not injuriously affect them.

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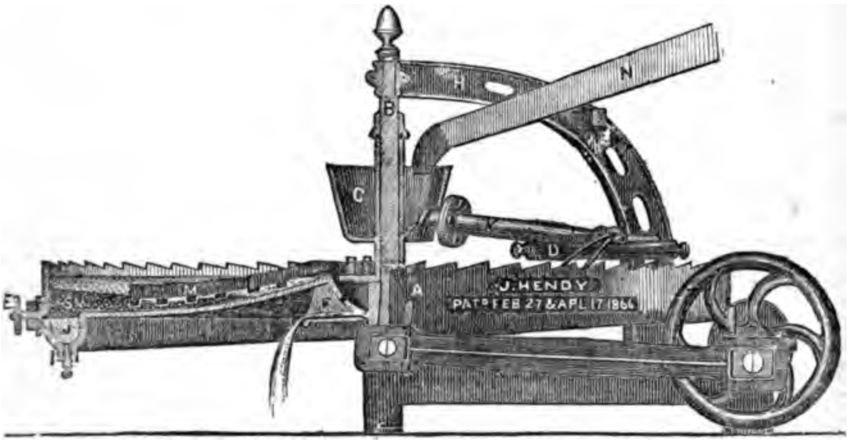
* Mémoire sur l'outillage nouveau et les modifications apportées dans les procédés d'enrichissement des minerais. Par Messrs. Huet et Geyler, ingénieurs, anciens élèves de l'École Centrale. Paris, 1866.

These advantages, and the necessity for machines that can be transported to distant regions unchanged, have been recognized in the United States, as already stated. Iron has for several years past been extensively substituted for wood in the construction of stamps, batteries, and concentrating machines in California and Nevada. Most of the concentrating machines and batteries now in use in California, Nevada, Idaho, and Northern and Western Mexico are made of cast iron. When such machines (made in San Francisco) arrive at their destination, they can be set up and put in operation at once, without requiring alteration or repairs.

HENDY'S CONCENTRATOR.

Hendy's improved continuously discharging concentrator, now most in use, is the result of long experience with the pan concentrators, and of their successive modifications and improvements. It consists of a shallow iron pan, five or six feet in diameter, supported by a vertical shaft in the centre, and made to oscillate back and forth by means of cranks on a shaft at one side, and joined by connecting rods to the periphery of the pan. The pan turns upon its vertical axis back and forth, for a short distance, at every revolution of the crank-shaft.

The figure gives an elevation of the machine, with the vertical shaft and one-half of the pan, shown in sections.



Hendy's Continuously-working Concentrator.

It is made wholly of iron, and thus there is no framing of timbers to be done when it is set up, and no shrinking and leaking after the machine has been allowed to stand idle for a time. A bed-plate, or frame, gives support to the central pin and the crank-shaft, and also to arched arms, H, that rise over the pan and sustain the upper end of the vertical shaft B. The bottom of the pan is not flat, but is raised in the centre around the shaft nearly to the height of the rim, and from this it descends toward the periphery in a cycloidal curve, an approximation to the brachystochrone, by which the movement of the particles from the centre toward the circumference is facilitated, and their passage in the other direction obstructed. This form is especially necessary, inasmuch as the motion and the centrifugal force diminish rapidly toward the centre. It constitutes one of the chief points of difference between this concentrator and others which have preceded it.

When the machine is placed for operation, it must be carefully leveled, so that water will stand at the same height at all points upon the outer rim of the pan. The stuff to be concentrated (usually the tailings from the amalgamated copper plates and blanket-strakes) is delivered, together with the water, by the trough N to the hopper C, from which it is fed through the pipe K and distributor D into the pan near its outer edge. This feeding is not confined to one point, but is made to extend around all parts of the circumference by causing the distributor D to rotate around the vertical shaft. This is accomplished by the movement of the pan. The upper edge of the rim is a continuous ratchet, into which two pawls, connected with D, drop during the motion of the pan *from* the distributor, and in the return motion the distributor is thrown back a distance equal to the arc passed over by the pan. Rake-like arms are bolted to the shaft of the distributor, and are also carried around the circle at the same time, and serve to stir up the compact mass of sand and sulphurets which settles upon the bottom. The crank-shaft makes from 200 to 220 revolutions per minute, thus throwing the pan back and forth an equal number of times, and keeping the materials in a constant state of agitation. The heavier substances, such as the sulphurets and any stray particles of quicksilver or amalgam, settle to the bottom, and accumulate in the lowest part of the pan, gradually displacing the sand and lighter materials, which, with the excess of water, flow over the raised bottom at the centre and out of the pan by a central discharge. The accumulated sulphurets discharge at the gate E, the opening of which must be regulated to correspond in its delivery with the rapidity of the accumulation. If opened too wide, sand from the layer above the sulphurets will be discharged; and if the opening is too small, the sulphurets will accumulate, and begin to flow over the annular bridge at the centre. For the accumulation of amalgam and quicksilver, a depression, J, is provided. This is deepest at the point of discharge I, closed by a plug. The sulphurets are usually allowed to accumulate until the pan is half full, as shown at S, before the gate E is opened. The sulphurets may be received into boxes or into troughs placed under the outlets.

These concentrators weigh 1,000 pounds each. They are run with a belt, and usually set in pairs, for which a single crank shaft is sufficient. Two pairs can be so arranged as to require a driving shaft only six feet in length. The amount of water required is not large; not more than flows away from the batteries with the sands to be concentrated. Each machine will receive and concentrate five tons of stuff every twenty-four hours. Eight tons have, however, been put through in that time; but the product is not entirely freed from sand, the presence of which is not objectionable in some processes of working, and if clean sulphurets are desired the discharge from four machines is delivered into a fifth, and this gives a complete, clean concentration.

At the North Star mine, Grass Valley, the performance of these concentrators has been highly satisfactory in saving not only sulphurets, but amalgam. One machine receiving the product of six, fed with the pulp from the batteries, gave a product containing ninety-five per cent of sulphurets. Like all the quick concentrators, however, they obtain a clean product at the cost of some loss of valuable material. Their tailings may, with advantage, be buddled.

This form of concentrator may be traced back, through various modifications, to the original Prater or Hungerford concentrator, known generally in 1864 as the Hungerford and Prater's concentrator,* when it was much used in California and Nevada. This machine received its motion in the same way, but was supported in a wooden frame, and the distribution of the pulp was effected by letting it descend from the center outward upon a fixed sheet-iron cover which extended nearly to the outer edge of the pan. It did not discharge the sulphurets; and when they had accumulated sufficiently the machine was stopped and they were dug out. The bottom was not curved downward from the bridge near the center, but had a gradual slope, as also in a later modification of the concentrator by Mr. Hungerford. This modification was patented in 1866, and consisted chiefly in doing away with the wooden frame by substituting one of iron. The distribution was effected as before, over a sheet-iron cap or cover, but a second or outer rim was added all around the pan, forming an annular trough, the only opening to which from the inside of the pan was a series of holes pierced at intervals near the bottom of the pan, with the object of allowing only the sulphurets, or concentrated stuff, to pass through into the outer space and to be kept there, out of contact with the sands and pulp undergoing concentration in the pan. Two openings in the rim of the outer compartment gave the means of drawing off the sulphurets. The discharge of the sand, water, &c., was at the center, and it was claimed to be a continuously working machine, but the delivery of the sulphurets was not satisfactory. The motion was given by two eccentrics acting upon wooden guide-blocks or bearings below the pan. Hungerford's latest machines are preferred by some mill-men to Hendy's, on account of their more solid construction and smoother running. I am informed that these particulars have been improved recently in the Hendy. The principal defect of that machine, whereon I have watched its operation, has been its too slight construction, support, and gearing. These features were the result of a desire to make the apparatus cheap and portable—a motive which has led more than one California manufacturer of mining machinery to sacrifice solidity and due proportion of parts.

All of these oscillating pan-concentrators may be regarded as modifications of the Borlase concentrator, which is an oscillating pan with a level bottom and a central discharge, the height of which can be varied by adding rings as the concentrated ore accumulates in the pan.

CONCENTRATION BY JIGGING.

The simple hand-sieve is the most ancient form of apparatus for sorting and concentrating ores in water by the direct fall of the particles, and it is still in use. Numerous modifications have been made from time to time, with the object of increasing the product by increasing the size of the sieve and supporting it in a frame, as in the hand-jig or brake-sieve, the construction of which is familiar, and by substituting machine power for that of the hand. Much attention has also been directed to the construction of automatic, or continuously working, jigs, by which the stuff to be washed enters in a constant stream, and, after being washed and concentrated, is delivered in two separate portions, without stopping or requiring manipulation.

In such machines the sieves, instead of being alternately plunged into and raised out of a vessel of water, are made stationary—are fixed firmly in a tub—and the water is made to alternately rise and fall, so as to pass in a strong current through the meshes of the sieve and the layer of ore above it. This motion of the water is produced by means of plungers or pistons acting below the sieve, either vertically or horizontally, or by elastic diaphragms, (as in Petherick's separator at Fowey Consols, 1831,)[*] which are alternately pushed out and in, as, for example, also in Edwards and Beacher's patent mineral and coal-washing machine.

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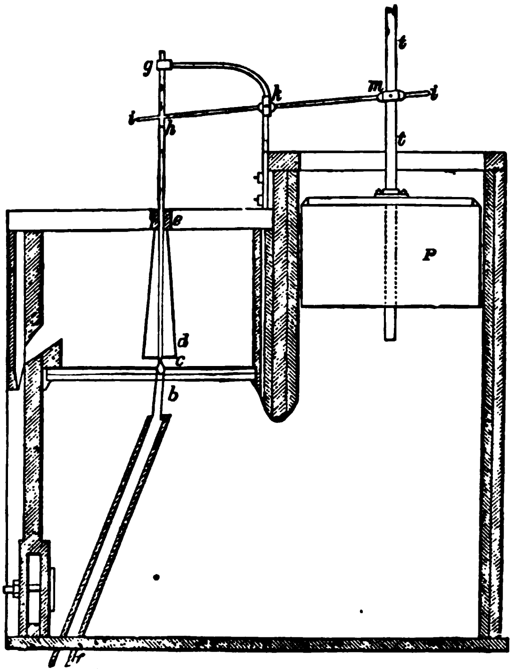
* The Prater concentrator was invented at Washoe in the year 1863, and patented December 5, 1864. Hendy added a self-discharging gate for the sulphurets in 1865, and a contrivance for tipping the pan to one side.

WIMMER'S CONTINUOUSLY-WORKING JIG.



Wimmer's Continuously-working Jig.

One of the simplest forms of the piston jig is shown in the figure. It is made of wood with a piston or plunger P at one side, which, on being forced downward upon the water in the box, causes an upward flow through the grate in the direction *b* to *c*. The peculiarity of this construction, due to Mr. Vogel of Joachimsthal, and Mr. Wimmer of Clausthal, is a valve in the center of the sieve through which the concentrated stuff is delivered as it accumulates, while the refuse passes off over the partition in front. But it was found that the downward current of water when this valve was opened was sufficient to carry down some of the waste stuff from the top; and it became necessary to devise some means of preventing this flow. This was effected by covering the outlet with a conical tube, *d*, supported from a bar of wood above and reaching down through the layer of poor stuff so low that only the heavy and richer portions resting directly upon or near the sieve can pass downward into the discharge pipe *b f*. This pipe is alternately opened and closed at the top by an iron stopper placed at the end of a vertical rod the upper part of which slides through a supporting ring, *g*. By means of an arm, *i*, supported on a pivot at *k*, the stopper is alternately raised and lowered as the piston P rises and falls. The opening in the discharge pipe is thus opened when the piston descends, and is closed when it ascends.[†] It has been found in practice, however, that this arrangement for opening and closing the discharge pipe does not give satisfactory results.

A somewhat similar machine, in use in the Harz, is shown in section by the next figures. The outlet in the sieve is surrounded by a perforated cylinder *d*, so as to prevent the refuse from entering, while the ore escapes through the tube and is delivered at the side. From five to six cubic metres of stamp stuff can be passed through this apparatus in twelve hours.

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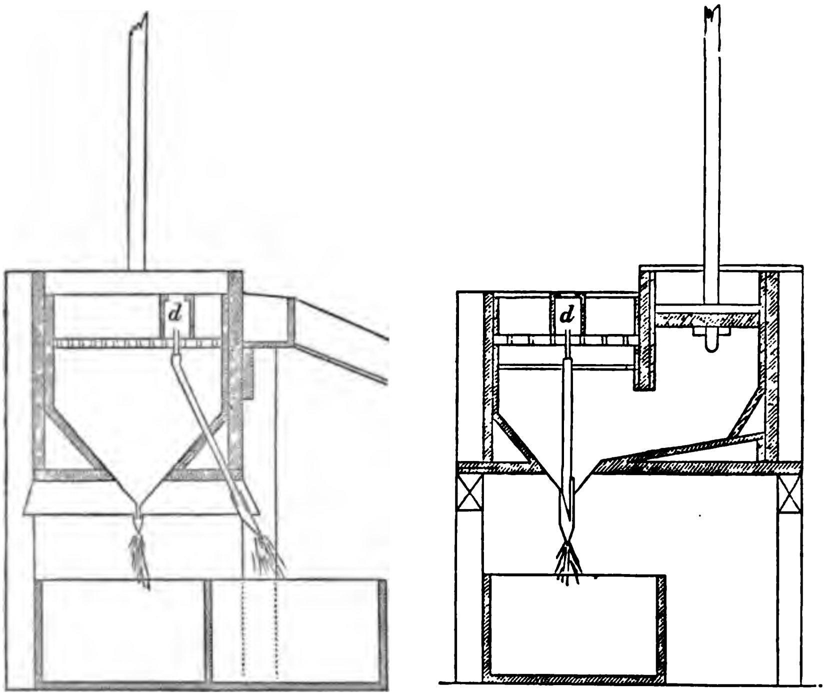
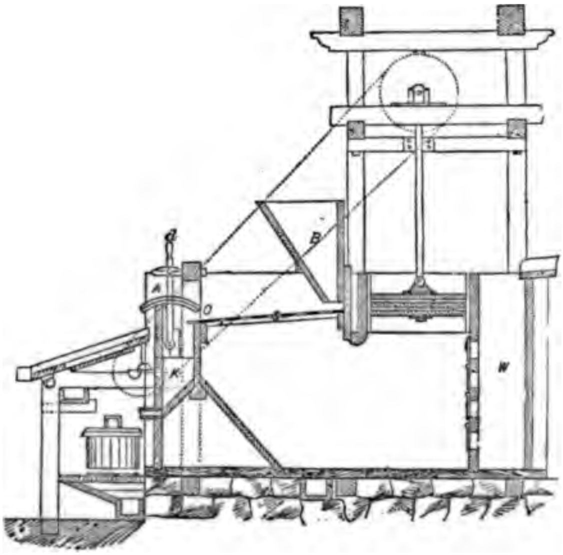
[*] Ure's Dictionary, supplement, p. 852.

[†] *Vide* La Préparation Mécanique des Minerais au Harz en 1857. **Rapport par M. Aug.** Gillon: Paris, 1858.



Self-discharging Jig—Harz.

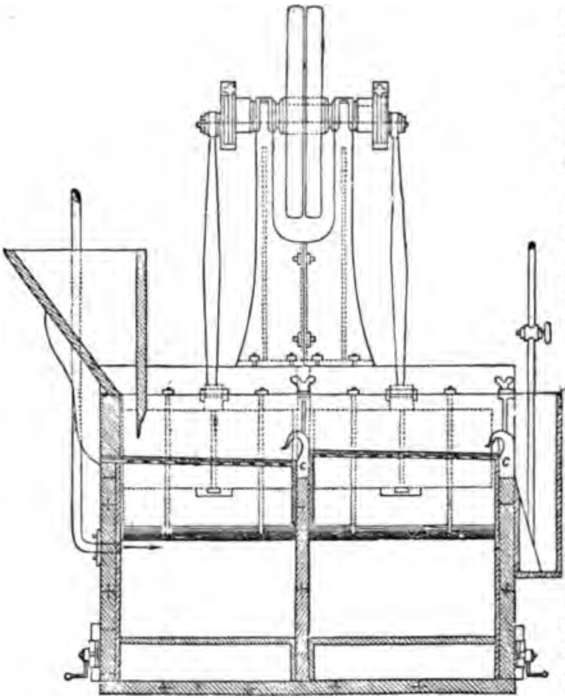
RITTINGER'S SELF-ACTING JIG.



Rittinger's Self-acting Jig.

One of the best jigs of the continuously-working class is the invention of Rittinger, and was exhibited at the great Exposition in Paris in 1867.

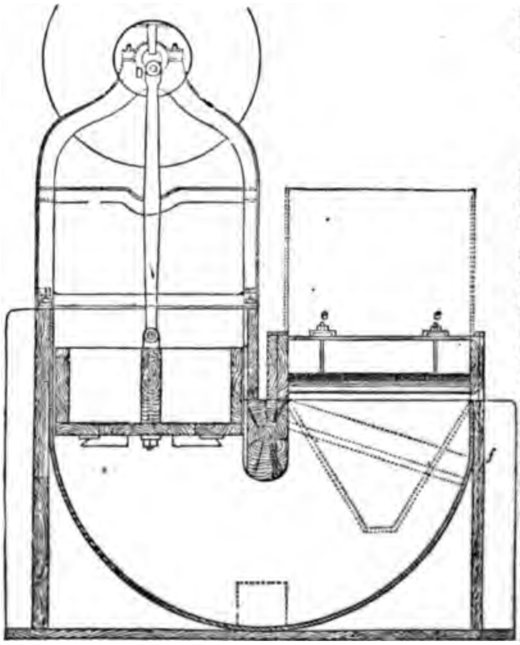
It is represented in the annexed figure and is characterized by the inclination of the grates and the lowness of the front partition, over which the poor and lighter stuff falls continuously, and with very little water, while the heavier and richer portions fall through the opening or slit *o*, at the base of the partition. This partition is the segment of a cylinder, and is supported upon the lever or arm *d*, so as to be movable back and forth in such a manner that the opening or slit *o* may be increased or diminished at pleasure. The heavy stuff, passing through the opening, falls into the box K, from which it is removed as required. The inclination of the grate in this machine is from five to eight degrees. It is fed through the hopper B, which plunges below the surface of the stuff accumulated on the grate. The loss of water which occurs at each stroke of the piston is replaced from a reservoir, W, at the back of the apparatus. According to Rittinger, experience has shown that the duty of self-acting machines of this kind is generally three times as great as that from the ordinary intermittent working apparatus.



Continuously-working Jig—Harz.

CONTINUOUSLY-WORKING JIG—HARZ.

In 1863 Mr. Geyer, an engineer from Baden, introduced continuously-working jigs into the great ore-dressing establishment erected by him on the banks of the Lahn. In the construction of these machines both wood and metal were employed. The arrangement of the parts is represented by the accompanying figures. It is a double machine, composed of two grates and two pistons, actuated simultaneously by means of cranks on a shaft above, the motion being communicated by two connecting rods. The grates are inclined forward, and are provided



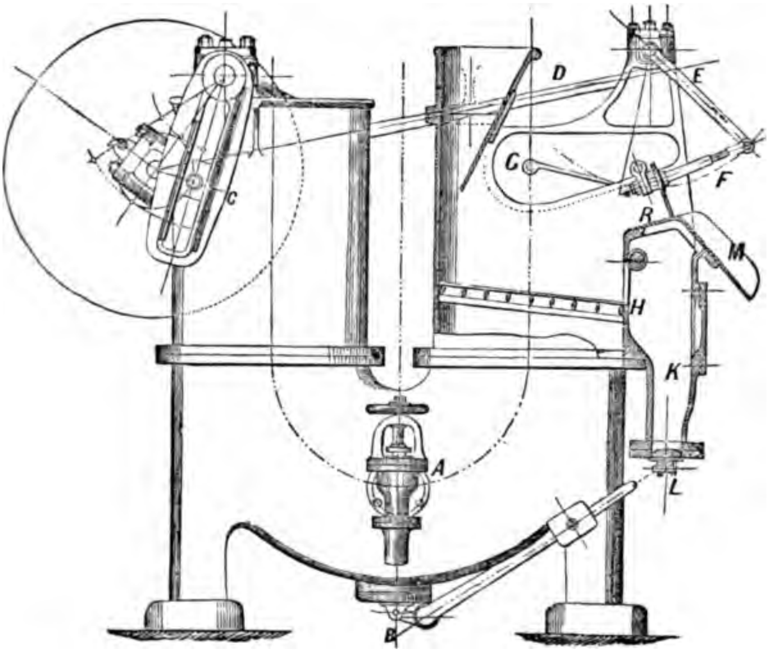
Continuously-working Jig—section through piston.

with a crevice or gutter at the lower edge, through which the concentrated ore falls into inclined troughs *c*. The stuff passes from one grate to another, and thus two different grades of fineness may be secured. Iron plates or partitions are placed so as to govern the discharge, and these may be raised or lowered at pleasure by the thumb-screws *e e*. These machines, worked at seventy strokes per minute, will wash about nine cubic metres of stamp stuff, diameter of $0^{m}.005$, in a day, and they require about 300 litres of water.

HUET AND GEYLER'S SELF-ACTING JIG.

Messrs. Huet & Geyler exhibited this form of jig at the Paris Exposition in 1867, and its satisfactory operation upon lead ore was witnessed by the writer. It is constructed of cast iron, and is very compact.

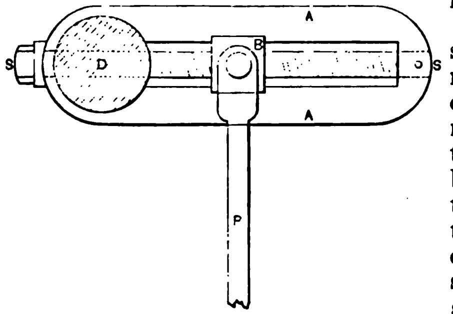
Most self-acting jigs require a large quantity of water, and this in many localities is a great objection to their use; but this jig is designed to work with but little loss of water, and, at the same time, by the aid of an automatic scraper, to increase the product.



Automatic Jig of Huet & Geyler.

The tub is shaped like the letter U, and is divided into two compartments, one for the piston and the other for the working grate. Water is supplied through the valve A, at the side, and the fine stuff or slime which falls through the sieve settles upon the botton, and is discharged through an opening, B, controlled by a lever reaching out to the front of the apparatus. The piston is operated by means of a shaft and crank, which works in an inclined slide, C, connected with a lever carrying the piston, so as to give a rapid descending stroke with a period of rest at the bottom, and then a slow upward movement; thus giving the most favorable conditions for the rapid and perfect separation of the stuff upon the grate.

The motion of the piston may be varied at will, in order to secure the best flow or motion of the water for different grades of ore. This adjustment is effected by shifting the position of the head of the piston along the lever or arm, and by this means increasing or diminishing the amplitude of its motion. The construction of this slide is shown in the figure. By turning the fixed screw *s s*, the head of the piston may be moved forward or backward.



The machine is provided with a scraper R, actuated by the long rod D, which is attached to an eccentric on the main shaft and moves the levers E and F, giving to the scraper a forward and backward motion over the top of the stuff upon the grate, and throwing out a portion of it at each movement. The path of the scraper is determined by the guides G, attached to each side of the tub. It can be varied by means of screws upon the lever or arm F. In passing backward, the roller or projection on the scraper, which follows the guides, rises upon the movable inclined plane G, and on its return passes below this plane, following the double-dotted line in the figure. The poor stuff from the top, which is constantly thrown forward and off by this scraper, falls over the front of the tub at R, along the chute M. The grate is inclined as in the machine of Rittinger, and the opening for the escape of the heavier and rich portion is similarly placed at the foot of the incline and just below the bridge over which the poor stuff is scraped. The opening is shown at H. It is closed by a valve which extends along the whole front edge of the sieve, and can be opened and closed at pleasure by a lever. The stuff passing through this valve falls into a receptacle K, from which it may be removed at pleasure through the opening L. The scraper is so made of perforated sheet-iron that it does not throw the water out together with the waste. These jigs are made with great care and accuracy, and work in a satisfactory manner, as the writer assured himself by personal inspection of the machine in operation near the Champ de Mars, in 1867.

KROM'S DRY ORE CONCENTRATOR.

This machine may be called an *air jig*. Dry ore in powder or coarse grains is subjected to sudden puffs of air from below, through a grate, precisely as water is forced up through a grate in the pump jigs. In this machine the dry ore is supplied automatically upon a horizontal sieve, and the concentrated portion is discharged upon one side and the refuse upon another. It consists of a receiver, to hold the crushed ore; an ore-bed, on which the ore is acted upon; gates, to regulate the flow of ore from the receiver and the depth of ore on the ore-bed; bellows, to give the puffs of air; a trip-wheel and spring, to operate the bellows; and a ratchet-wheel and pawl, to operate the discharge roller. There are six projections on the trip-wheel, and therefore the moderate speed of 50 to 70 revolutions per minute of the trip-wheel shaft gives 300 to 400 movements to the bellows, and a corresponding number of puffs of air. This rapidity is a great advantage. The use of water in concenı admits only from 50 to 80 lifts per minute, while in air from 300 are obtained. This is due to the fact that bodies fall much more y in air than in water.

sieve or ore-bed is made of wire gauze tubes, placed from one- r to one-half of an inch apart, according to the kind or grade of ·· be treated. The concentrated ore settles down in openings en these tubes, and accumulates in a reservoir from which the rge is regulated by a roller, so as to keep it filled and thus form a rt for the upper layer of ore to be acted upon.

experimental working of this machine is certainly very satisfac- and it is claimed for it that it will accurately separate zinc-blende ;alena—a severe test. The machine measures five feet by two feet, e feet ten inches high, and weighs about 800 pounds.

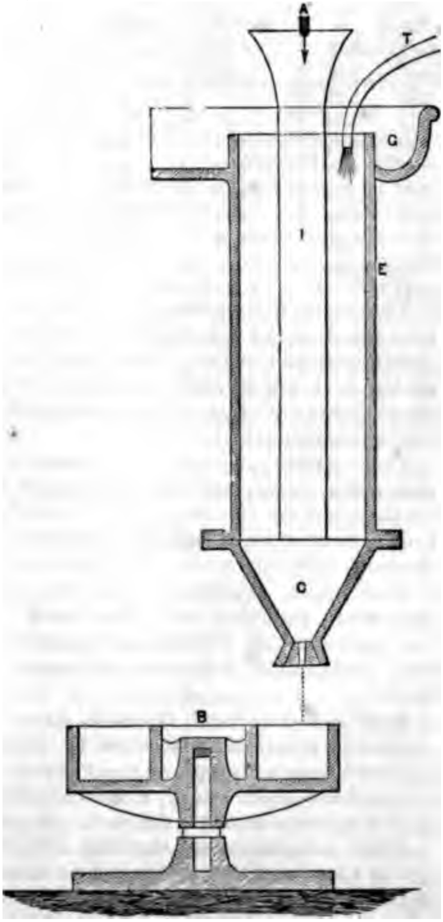
:ATION OF ORES BY FALLING THROUGH A COLUMN OF WATER.

ious forms of apparatus have been devised to effect the separation grains of either coarse or fine stamp stuff having nearly the same e, but differing in density, by allowing them to fall through a n of water either at rest or tion. Such machines may garded as modifications of g; a greater length of fall materials in water being tuted for a succession of falls, the result of the re- l shocks or jerks given to eve. Apparatus of this kind a connecting link between nd the slime separators.

se machines depend for operation upon the differ- n the time required for par- to fall through a given t of column of water, which, articles of equal size, is in der of their specific gravi- As the time required is ied by the bulk of the par- a careful sizing is an essen- requisite to the success of orm of concentrating appa-

of the simplest forms is a nary cylinder, designed by s. Huet & Geyler, and ex- d at the Exposition in Paris, It consists of two station- oncentric cylinders, E and t full of water by means of ply pipe T, while a portion water escapes through the ng in the conical bottom C, he excess overflows at G, d the top.

ectly below the aperture in



Huet & Geyler's Separator.

the bottom of this cylindrical vessel, a receiving tub B is placed, so as to receive the water and ore that fall through. This tub is divided into compartments and rotates around a central vertical axis. The stuff to be concentrated is supplied *at intervals* at the top of the cylinder I, at A, and falls in the direction of the arrow. In falling through the three feet of water, the particles separate according to their specific gravity, and the heaviest arrive first at the outlet and are caught in one of the compartments of B. As the next grade of ore reaches the outlet, the tub B has turned so as to bring another compartment under the orifice, and the stuff is thus classified. The revolution of B must be carefully timed to the rate of descent of the particles and the interval of the periodic changes.

The following tabular statement shows the time required for the fall of stamp stuff of different minerals, and of different diameters:

Size of the gravel in millimetres.		Galena, gravity 7.56.	Pyrites, gravity 4.60 to 5.00.	Barytes, gravity 4.50.	Blende, gravity 4.15.	Quartz, gravity 2.70.	Carbonate of lime, gravity 2.60.
From	to	*Seconds.*	*Seconds.*	*Seconds.*	*Seconds.*	*Seconds.*	*Seconds.*
30.00	18.00	0.90	....	....	....	2.36	....
18.60	7.00	1.11	....	....	....	3.67	....
7.00	5.50	1.50	....	....	....	4.61	....
5.50	4.44	1.84	....	....	....	6.10	....
4.44	4.17	2.03	2.54	2.81	2.88	7.27	3.86
3.94	3.67	2.48	3.43	3.73	4.61	7.61	5.50
2.77	2.50	3.11	4.41	5.55	6.53	....	6.83
1.77	1.50	4.14	6.21	8.30	9.78	....	10.17
	1.00	5.27	10.36	11.33	11.67	14.64	17.21

This table shows that the velocity of the receiving tub must be proportioned to the size of the particles of the stuff to be separated and to the height of the fall. For a height of $1^m.00$, the number of revolutions of the tub per minute must be, for particles of $0^m.016$ in diameter, 21 revolutions; $0^m.004$, 11 revolutions; $0^m.001$, 6 revolutions; $0^m.00025$, 2.7 revolutions.

This apparatus has not yet been long enough in practical operation to prove its value, and it requires to be studied and experimented with further before the results will be satisfactory, yet it has already been found that a thorough classification of the stuff is essential; that the feeding and the motion of the rotating tub must be regular; that the grains which separate best are those between $0^m.004$ and $0^m.01$ in diameter; and that with fine stuff the results are incomplete. When the particles are $0^m.014$ in diameter, and have a density of 3.15, they will precipitate from compartment to compartment, in the following order:

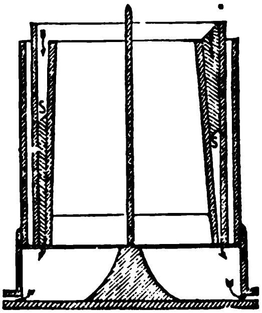
First compartment, density, 4.2; 7 per cent.
Second compartment, density, 3.2; 52 per cent.
Third compartment, density, 2.9; 24 per cent.
Fourth compartment, density, 2.9; 12 per cent.
Fifth compartment, density, 2.9; 3 per cent.
Sixth compartment, density, 2.8; 2 per cent.

For the particles of $0^m.014$ in diameter, the proper number of turns is three and a half, and for particles of $0^m.004$, five turns. One of these contrivances will deliver about 750 quarts of gravel per hour.

HUNDT'S SETTLING TUB.

Hundt's settling tub operates similarly, but differs in this, that the receiving tub is *fixed*, and the water column is made to rotate. The ore is not supplied in the center of a column of water, but into an annular or cylindrical column in a continuous stream, differing in this respect also from the first described apparatus. It is a continuous working machine, designed to separate or sort the particles according to their velocity of fall through the column of water. The particles of stuff entering this machine are subjected to two motions, the direct fall due to gravity, and the movement of translation due to the motion of the water. It follows that they take a diagonal course and reach the bottom at different distances from the point at which they entered the column.

This apparatus was first used at the Landerkrone mines, near Wilnsdorf, in 1854. It consists of a circular tub, within which an open cylinder is supported and made to revolve by a vertical shaft. This cylinder is partly closed by means of a cone, so adjusted that only an annular opening is left, 5 centimetres wide at the bottom, and 13 centimetres at the top. The outer tub is $1^{m}.75$ in diameter, and is 2 metres high. The inner cylinder is $1^{m}.60$ in diameter. Small partitions, *s s*, between the cone and the cylinder serve to carry the water filling the space around with the cone and cylinder during their rotation.

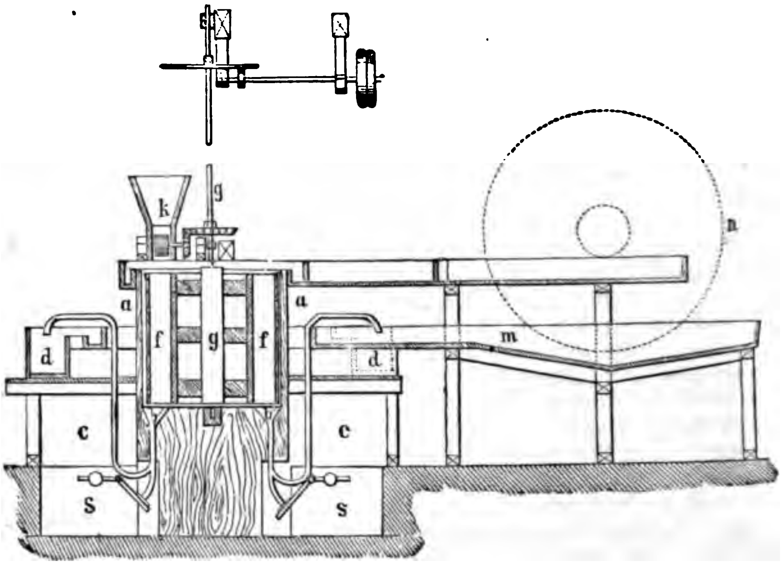


Hundt's Settling Tub.

The stuff to be treated is introduced in a continuous stream at the top, and in falling through this height of two metres of water, and being at the same time carried around by the revolution, is classified according to the rapidity of the fall of the particles. It may be withdrawn from the vessel by suitable openings around the bottom. By careful management of these openings, very little water is lost; and this economy of water, and the very small quantity required for the proper working of the apparatus, renders it especially worthy of the attention of mill-men and metallurgists, in such regions in New Mexico, Arizona, Nevada, and Sonora, where water is scarce. The number of revolutions of the drum should range between 2 and 6 per minute, the diameter being 4 feet, and the size of the grain from $\frac{1}{32}$ to $\frac{1}{2}$ of an inch. Used with ore-stuff particles of which differ in size, the machine sorts these particles according to their rate of fall. As the product in such a case would consist of small and dense particles mingled with larger ones of less specific gravity, the separation can readily be effected by the simple operation of sifting.

RITTINGER'S SETZ-RAD.

The apparatus of Rittinger is upon the same principle as Hundt's, and it is not clear which was suggestive of the other. It is a self-feeding continuous working machine, and consists of a stationary wooden tub *a a*, the bottom of which is divided into eight conical compartments connecting with pipes *c*, which, after descending for a short distance into the foundation, turn upward and outward, and are curved at the end so as to deliver the water from the tub into an annular trough *d*. A double cylinder, *f f*, supported by a shaft, *g*, is made to turn in the tub *a*. The stuff to be separated is delivered in a constant stream through the hopper and distributor *k* into the revolving cylinder, and falling through the water in this space is sorted and collected in the conical reservoirs and tubes *b*. A branch tube, closed by valves *s s*, permits the removal of this concentrated stuff from time to time. The waste stuff delivered through the tubes *b* into the annular trough *d*, flows into another trough or conduit *m*, whence it is lifted by the wheel *n*, and returned to the tub *a*.

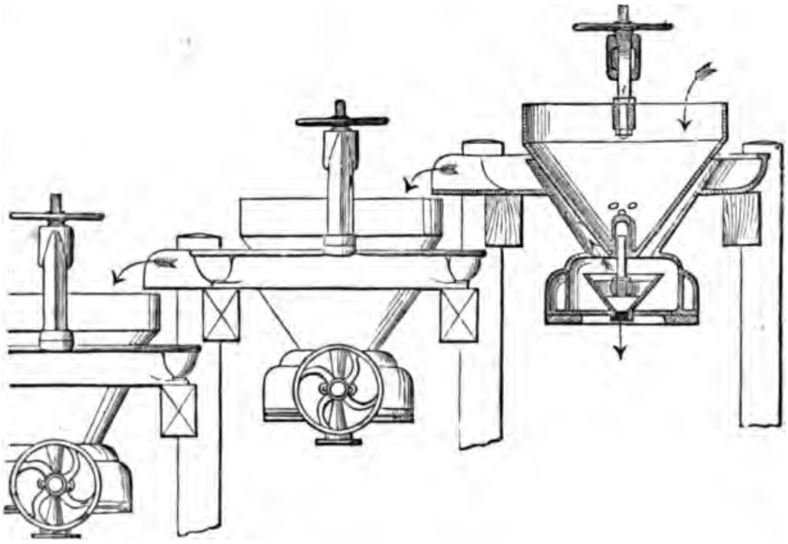


Settling apparatus of Mr. de Rittinger.

Rittinger in his *Aufbereitung* describes a machine of similar construction, in which the stuff is not received into an annular column of water, but into an ordinary tub in which the water is made to revolve by a wing-wheel, the wings of which would correspond in position to the sections of the cylinder *ff* in the last figure. The bottom is divided into eight radial compartments ending in funnel-like cavities, as shown. With grains of lead ore $\frac{5}{32}$ of an inch in diameter, 91 per cent. of all the lead-ore contained in the stuff will be delivered into the second compartment at the bottom, and 8 per cent. in the next. But with grains $\frac{1}{32}$ of an inch in diameter, only 75 per cent. will be found in the second, and 20 per cent. in the third compartment.

SLIME SEPARATORS AND SORTING BOXES.

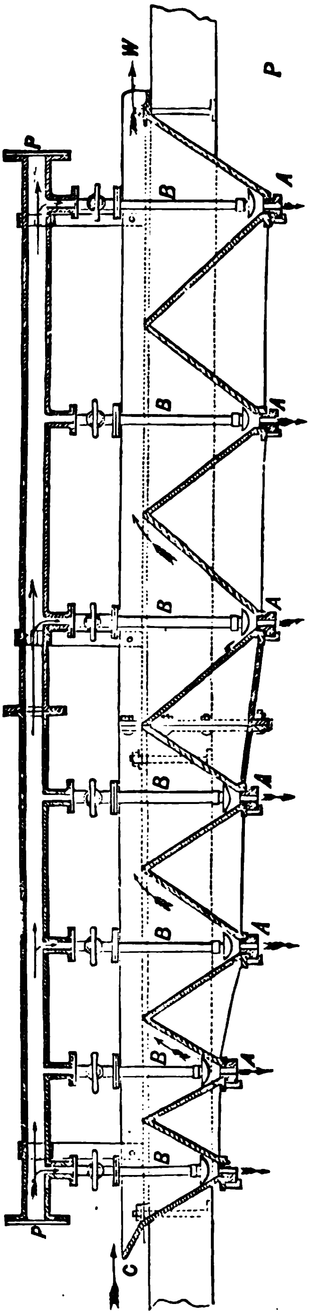
A convenient and effective form of the cone apparatus is here shown on a scale of $\frac{1}{25}$, the upper cone in section. A complete series is usually composed of five or six, arranged in succession, one below another, as shown. The construction is very simple; and they can be made of cast-iron, so as to be very durable, and at the same time exact in form. Each part consists of two cones, one inserted in the other, so as to leave an annular space in which water flows upward from a reservoir or chamber at the lower, or pointed end. The stuff to be concentrated is conveyed by a launder into the upper cone, and, passing through holes, encounters the upward current. The largest of the stuff so fed should not exceed three-quarters of a millimetre in diameter. The lighter portions are at once carried upward and over the upper edge of the inner cone, and fall with the escape-water into an annular trough, by which they are conducted away to the next lower cone, while the particles of sufficient weight to resist the current fall through it, and accumulate in a small inverted cone, in the chamber below, from which they are allowed to drop by the small aperture at the apex in the direction indicated by the arrow. This orifice is controlled by a valve, and can be regulated at will, according to the rapidity of the accumulation. So, also, by means of a screw above the upper cone, the distance between the cones can be regulated according to the necessities of each case. The apparatus requires considerable water, and the overflow from one cone is carried to the next, and so on in succession.



Conical Separators.

RITTINGER'S SEPARATING TUBS WITH ASCENDING CURRENTS.

This is another modification of the conical tubs or pointed boxes, but the shape is rectangular, and the water current is not confined to a narrow zone or space between partitions. This form consists of a succession of deep trough-like depressions placed edge to edge, and gradually increasing in size and depth. But as the ends and sides are the highest, the series forms, in reality, but one vessel, the water covering all of the intermediate edges, and thus permitting a continuous flow from one end to the other. This will be seen from the inspection of the figure. Seven compartments, B B, are shown, and the direction of the flow from C to W is indicated. The whole series is supported upon a frame at such a height that the attendant can pass under it, and reach the openings at the apex of the pyramidal tubs, at A A, where the concentrated stuff flows out. A supply-pipe, P P, delivers clear water into each compartment through a branch pipe reaching nearly to the bottom. The stuff entering at C deposits the heaviest particles, and, aided by the ascending flow of water from the pipe, the lighter portions pass over into the next tub, and so on. The flow of water into each compartment must be carefully regulated. As the size of the compartments increases, the ascending current has less and less force, and finally only the very lightest and poorest portions are carried away.



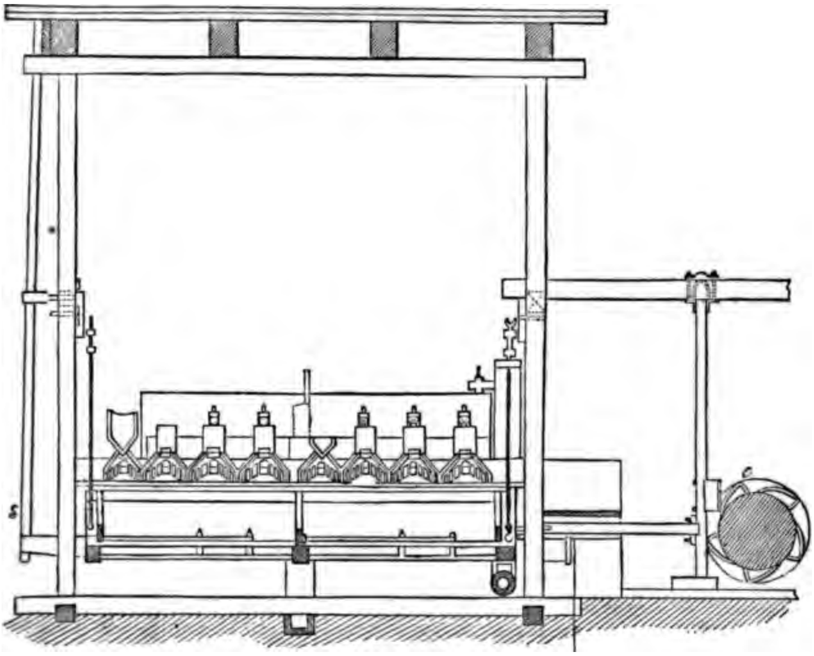
Rittinger's Separating Tubs with ascending currents.

The arrangement gives very satisfactory results. It requires from 120 to 150 quarts of water a minute, and will separate about a ton of battery pulp in each hour. It may be constructed either of wood or of iron. The apparatus shown in the figure is made of iron.

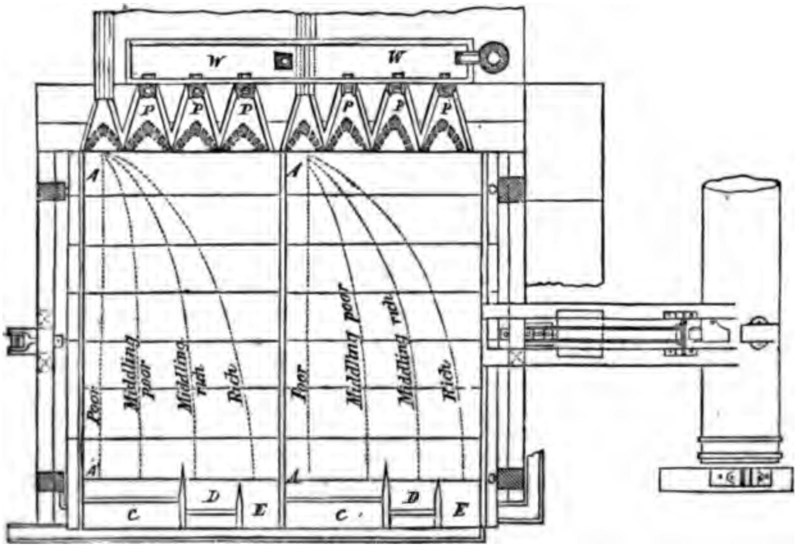
RITTINGER'S CONTINUOUSLY-WORKING STOSSHEERD.

This is another and important machine for concentrating by the flow of the stuff over a plane inclined surface. It has, in addition, a percussive shock, given laterally at right angles to the flow, and not parallel with it, as in many of the inclined tables, and, for example, in Hunter's concentrator.

It consists of a wooden table or platform, about eight feet long and four wide, suspended at the four corners, and inclined forward so that water and fine stuff poured upon the upper part will flow evenly down to the front edge. A lateral throw and percussion is given to the whole table by means of cams, *c*, upon a shaft at the side, and the reacting wooden spring S upon the opposite side of the table. Two tables are usually combined in one, and they are separated by a narrow strip of wood extending the whole length; similar strips are placed on each side of the table, and serve to keep the water and stuff from flowing off. The stuff to be washed is delivered upon the tables at the upper left-hand corner, at A. The distributors P P P furnish clear water. While the table is at rest, the tendency of the stuff is to flow down the slope in a direct line from A to A′. By means of the lateral percussion, however, the path of the heavier particles is changed, and they are gradually thrown from left to right, along the surface of the table, at right angles to the direction of the current of clear water. This current tends at the same time to sweep the particles downward, and it acts upon the light sterile matters more rapidly than upon the heavy ore. The result is, that the heavier and richer particles are gradually separated from the poor stuff and describe the path upon the table indicated by the dotted lines. By the time the particles have reached the foot of the table, the richest portions have been transferred to the corner of the table diagonally opposite to that upon which the stuff entered, and they flow off into the compartment E. The "middlings" are dropped into the next compartment D, and the poor falls into C.



Rittinger's Continuously-working Stossheerd—front view.



Rittinger's Continuously-working Stossheerd—view from above.

supplied at the circumference of the circular or annular table, and is discharged into different compartments at the centre.

The foundation plate sustains the distributing pipe, the water pipe, the waste gutter, and the driving shaft. An endless screw upon this shaft gives motion to the concave table. Experience in using this buddle has shown that it is desirable to have a greater number of sprinkling pipes than are generally used in the Harz. It is said that the washing of the stuff is completed in one operation, while with the German construction it sometimes happens that the stuff must be passed twice over the machine to obtain an equal result.

The convex buddle is also an annular table, but instead of sloping inward toward the center, it slopes from the center outward, being the reverse of the concave buddle. The stuff is supplied on the inner margin and flows outward to the lower edge, and is delivered into a succession of annular troughs.

The construction is similar to that of the concave buddle. A cast-iron frame supports the table, the driving shaft, the water pipes, and all the fixtures. The tangent screw and the driving shaft work in a hollow case of cast-iron.

ARRANGEMENT OF A COMPLETE SILVER MILL.

In conclusion I present, by an engraving annexed, a general view of the construction and arrangement of the parts of a complete dry-crushing silver mill, as constructed January, 1870. It hardly needs explanation. The ore received at the highest point falls from one machine to another, and is handled as little as possible. It passes from the dump pile under the car *a* to the rock breaker *b*; thence over a sheet-iron drying platform at *e* to the feed-box *d*. After stamping it is roasted in the furnace *g*, and is worked in successive charges in the pan *i*, from which it is drawn off into the settler *j*, and finally passes through the concentrator K. The amalgam is retorted in a cast-iron retort set in a small furnace outside the building.

SECTION VI.—WINDMILLS.

CHAPTER LXXXIII.

WIND AS A MOTOR IN THE MINING DISTRICTS.

lready the scarcity and dearness of fuel for steam machinery is a
y expense upon mining and metallurgical operations in many of the
sely wooded or desert mining regions of the great interior basin of
continent. In different districts, different expedients have been
ted or proposed for relief from this great and growing burden.
er-power is, of course, scanty in those places where there are no
. If there were more water in the country, there would be more
, and so more fuel. Devices for saving fuel in the generation of
n are much in vogue among the engineers; and, without stopping
to condemn or recommend anything of this kind by name, I would
in general, that the construction of the boiler and fire-places is a
er of great importance in the mining districts of the far West, since
all saving in fuel, or time and labor, represents a large saving in
ey, where wood and wages are so high. At Virginia City, Nevada,
mill-men are helping themselves with a railroad, by means of which
will be able to obtain fuel from the inexhaustible forests of the
ra. Along the line of the Pacific railroad, from Laramie on the east
orinne or Elcho on the west, the fine coal of the Rocky Mountain and
atch beds will doubtless be introduced as a substitute for wood. It
ot be surpassed as a steam-coal; and some of the beds, it is hoped,
be found suitable for metallurgical purposes—if not for blast fur-
s, at least for reverberatories.

t there are regions, for example, through Central Nevada, stretch-
from Cortez to Pahranagat, which are remote from railroads, water-
er, and coal-beds, and which, if their mines are developed with the
r they deserve and will repay, are certain to experience great dis-
for want of motive power to drive the machinery of their mines
mills. The feeble, scattered growth of pine-nut trees in the moun-
cañons of these districts will not long support an active industry.
have heard a good deal, since the new philosophy of heat came in,
tilizing the heat of the sun. Captain Ericsson's famous letter on
solar engine, which he proposes to construct, and by which he ex-
s to transform radiant heat into horse-powers by the thousand, is
in the minds of most readers. Other (and possibly less trustworthy)
ntors have plans for availing themselves of the electricity generated
e earth or the elements. Some time ago, an aspiring chemist
ned our admiration for his process for reducing ores by means of
der-storms. But it has been abundantly shown that electricity, as
tor, is too costly to be used with profit; and, as for Captain Erics-
solar engine, we do not yet hear of it on a large working scale.
over, there are one or two reasons for preferring a somewhat dif-
t utilization of the heat-power of the sun. The philosophers are
ed that great loss of power inheres in all our engines for converting
into motion. Nature produces motion more cheaply than we can;

and our water-wheels avail themselves of her quiet economy. But there is a more direct medium than flowing water between heat and motion, namely, moving air; and in all the range of mechanical motors the windmill is perhaps at once the most neglected and the most promising.*

The windmill's weak point is its dependence upon the weather; but the solar engine would be still worse in this respect, for, taking the year together, we may say that it blows oftener and longer than it shines. Twelve hours out of twenty-four there is no sun, though considerable wind. Water-powers are also, in a less degree, open to the same objection. They stop for dry weather, cold weather, and very wet weather. Nothing but steam may be thoroughly depended upon at all times to do the full duty expected of it. But this advantage of steam is measurable in money; and at some times, in some places, the price of fuel may be so great as to overbalance it.

Moreover, it might be well worth while, in some cases, to employ some of these motors, even though a steam-engine should stand idle, waiting to be used when sun or air or water failed. Stamp mills are at present frequently built so as to be geared as need dictates, either to a water-wheel or to an engine; and it is one of the disadvantages of the "direct-acting steam stamp" that it must have steam, and can never be employed with cheaper motors. Besides, we are not at the end of our resources concerning the storage and equal distribution of the fitful sources of wind and sunshine. By the elevation of water into a reservoir, or by the raising of heavy weights, it would be possible to accumulate power while the motive forces were acting, and thus obtain a regular supply for what would otherwise be wasted hours. The practice of hydraulic miners who buy water of ditch companies, and let it run from the ditches into their private reservoirs for twenty-four hours, so that during the ten or twelve hours of labor they can use it in a double stream, is precisely the reverse of that to which we refer; but it proves the practicability of both. The hydraulic miner wishes to obtain a greater force during a less time, and to that end accumulates the results of a steady power during a longer time. It would be scarcely more difficult, by employing great power for a short period, to obtain results which could be beneficially distributed through the whole day. Our inventors might profitably turn themselves to the consideration of the best mechanical contrivances to facilitate this exchange of force and time. But, finally, there are many kinds of work to which machinery is applied in mining that need not be continuously performed. If windmills perform the duty of draining the low coasts of Holland, or irrigating the arid plains of California, there is no reason why they should not be so constructed and arranged as to do the pumping in many of our mines, where the depth is not great nor the amount of water excessive. I might even say that if the grist-mills could wait (as in the good old times they were fain to do) for a fair wind to do the grinding, even a quartz-mill might be run, though with much vexatious interruption, on the same rude plan. Cessations for want of wind would be less common than the reader might suppose. Precisely those regions where scarcity of fuel and water-power might lead to the expedients we are discussing are noted for their perpetual winds.

Certainly it seems a pity that men should suffer so much pains and loss by reason of the expense and difficulty of the motors to which they are accustomed, while every breeze that whistles over their heads is piping of power unheeded and running to waste. Possibly the highest science, as well as the most practical economy, may dictate a return to this motor of our fathers, and a development of its capacity in the light of that mechanical perfection which has been bestowed upon other machines. I would not be understood, however, as declaring any universal and hitherto unacknowledged superiority of windmills. It is enough to say that windmills are likely to be the best we can choose in certain cases where, before long, we shall have to choose that or nothing.

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* For valuable notes and suggestions in connection with this subject, I am indebted to Dr. P. H. Vanderweyde of New York, himself a native of the country of windmills, though for many years a well-known resident of the United States. Mr. Blake is not responsible for this chapter.—R. W. R.

But if we would learn the best practical construction, and appreciate the great capacity, of windmills, we must look to those countries in which they have been most thoroughly studied and most widely employed. It is said that this device was brought from the Orient by the Crusaders, and introduced in the sixth century into France, Flanders, and Holland. Northern Germany, however, claims the invention, in the eleventh century, of the large post-windmills called Bock mills, which will presently be described.

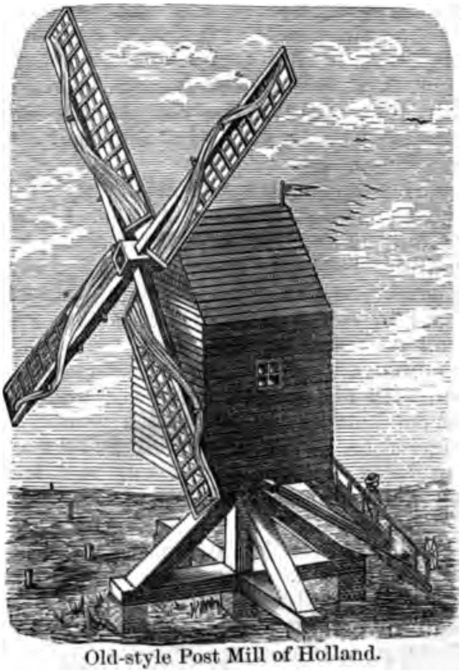
But Holland is, above all, the country where this motor has been most extensively applied. The civilization of that state, nurtured into early maturity by the natural obstacles with which it was forced to contend, was for a long time in advance of that of the rest of Europe. The sea was at once its greatest benefactor and its devouring enemy. In regions possessed of a varied topography there is natural drainage, resulting in natural water power; but the low, flat surface of Holland at once demands the drainage and denies the power. Besides the necessity of power for pumping, there was also from early times grain to be ground for the food of the inhabitants, and timber to be sawed for marine and civil architecture. Long before the introduction of the steam-engine, in fact for more than a thousand years, the power of the wind has been employed by the industrious Hollanders in the performance of these duties; and even at the present day, though the great modern motor is fully understood and appreciated in that country, the old favorite still holds its place, and Holland possesses the largest windmills and the largest steam pumping engines in the world.

Some notion of the amount of work performed by windmills in Holland may be derived from the statement that, between 1440 and 1850, more than a hundred large and small lakes, having a total area of a quarter of a million acres, were drained by this means, restoring this amount of most fertile soil to settlement and cultivation. In the drainage of the great Haarlem Lake, and of a few smaller ones, steam was introduced in 1845, but it is still an open question whether wind could not have been more economically employed. Holland possesses neither coal-mines nor forests; and steam, with all its advantages of uniform and continued availability, cannot compete in economy with wind. It has been used in the instances referred to, and is employed as an auxiliary, or held in reserve in certain localities, where, in occasional seasons of much rain, coinciding with little wind, the windmills in use have been found inadequate to perfect drainage.

It may be mentioned, in passing, that this region possesses large deposits of peat, and that dried peat or turf is a common fuel. The use of peat as a steam fuel has therefore been naturally a subject of much interest, and has received thorough investigation. It has been found inferior to coal, and though the densest varieties are superior (weight for weight) to wood, their greater bulk and too rapid combustion render them inconvenient and undesirable for this purpose.

Concerning the usefulness of windmills for operations requiring small power, nothing need be said. They are extensively used on the Pacific coast in raising water for irrigation; and they might with advantage be employed generally by farmers and others for numerous domestic purposes, such as churning, turning grindstones, &c. I think their application would be more extensive in this country but for the numerous patented and more or less complicated modifications, which tend both to increase their cost and to limit their power.

There are two great classes of windmills, distinguished by the position of the sails. The vertical mills have their wings or sails so placed as to turn in a nearly vertical plane, about an axis nearly horizontal; and the horizontal mills have their wings turning about a vertical axis. The latter are far less effective, giving for the same surface of sails and strength of wind, according to Sir David Brewster, not more than one-third or one-fourth as much power as the former. They are seldom constructed, except in situations where the necessary height cannot be given to vertical sails. I have seen some of them along the Pacific railroad, employed for raising water into tanks for locomotive supply. As might be expected, they do not give satisfaction. The secret of their comparative inefficiency is the small surface exposed to the impulse of the wind at any one moment, and the interference of the wind passing through and striking the backs of the opposite sails. The mechanical contrivances intended to obviate this difficulty by a continual adjustment of the sails are liable to derangement. At all events, the vertical mills are more suitable where great power is desired, and this is the purpose to which I desire to call particular attention.

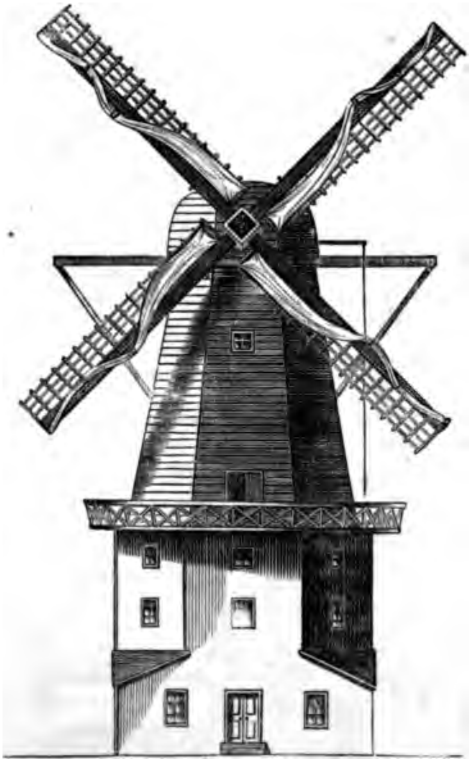

Old-style Post Mill of Holland.

The vertical windmills may be divided again into two classes, in the first of which the whole mill building is revolved, so that the sails may face the wind from any quarter, while in the second only a dome revolves, carrying the sails and their axis, while the building with its machinery remains stationary. The former are the post or Bock mills, to which allusion has already been made. Their construction may be understood from the accompanying illustration, which, with the two following, has been kindly lent me by Messrs. Western & Co., publishers of the Manufacturer and Builder, a pictorial monthly magazine of New York. A strong, conical tower of heavy timbers, from ten to twenty feet high, rests upon five piers of masonry. At the apex of this framework is a pivot or column of iron, fitting into a corresponding socket or box in the floor of the mill. Upon this column the mill rests and revolves. The building is entered by means of a staircase extending nearly to the ground, on the side opposite the sails, and so strongly built and braced as to furnish a convenient point for attaching the ropes or chains which anchor the mill in any desired position. A dozen posts are set firmly in the ground about the tower, and a capstan wheel is attached to the bottom of the staircase, with two ropes or chains around its axis. These are made fast to the nearest posts, one on each side of the staircase, and the mill is thus held securely as long as desired. The revolution is effected by pushing a stout lever, which projects downward from the mill.

It should be remarked that in Holland all contrivances for turning the mills by vanes or otherwise, through the action of the wind itself, or for regulating the position of the sails by mechanical contrivances, operated by the greater or less force of the wind, have been abandoned. They are only applicable on a small scale, as a little consideration will show. The force or change in force of the wind which would suffice to operate such devices in small, toy windmills, such as are frequently used in this country, would not suffice to turn a heavy building or adjust large sails, such as are required for the development of many horse-powers.

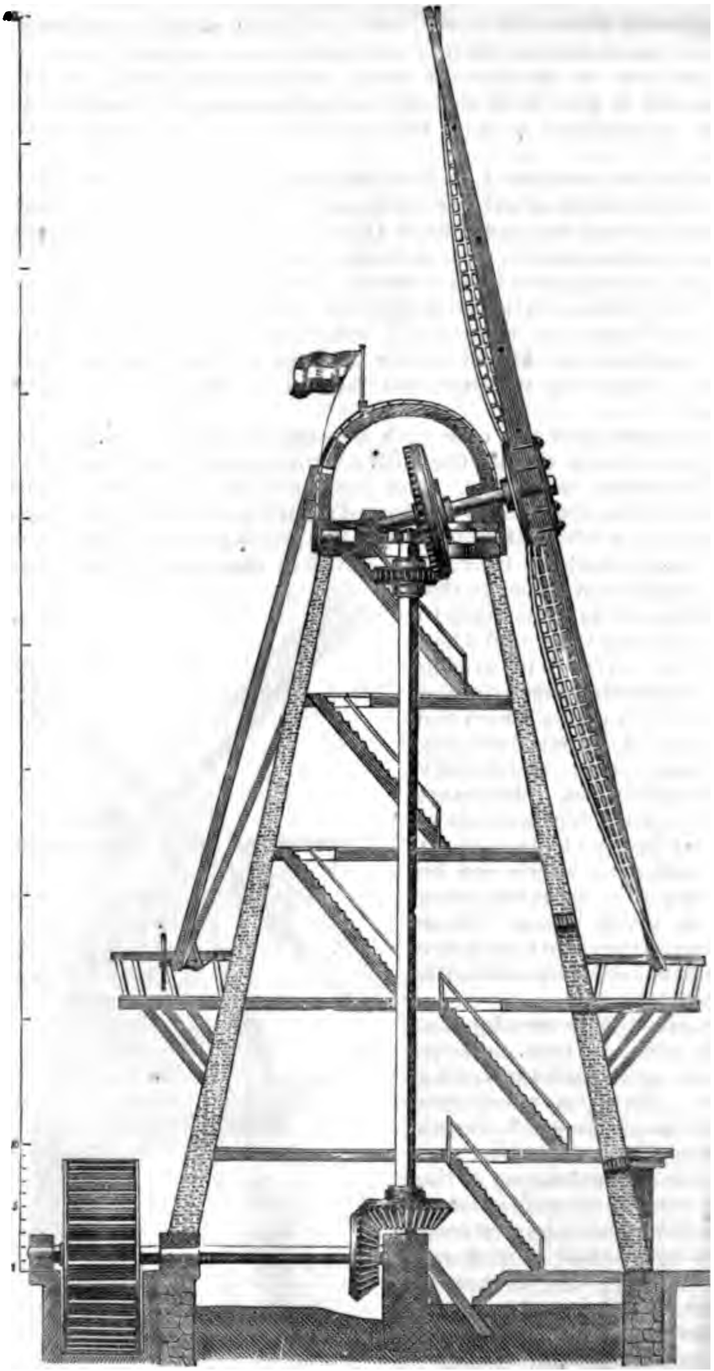
This is especially the case with the other class of vertical mills, invented in Holland during the 16th century, and hence known in Europe as the Holland windmills. The post-mills are convenient enough for grinding grain, since it is a matter of indifference where the grindstones are situated, or where the entrance of the mill is found; and the revolution of the whole mill on its vertical pivot is therefore not objectionable. But in driving a wheel to displace water, it is impossible to carry the channel around when the mill turns; and in sawing lumber it is highly inconvenient to have the floor on which the saws are working, the discharging doors, &c., continually changing position. Moreover, the size of sails and amount of power are limited by the weight of the structure which can be supported and revolved upon the iron pivot below. These considerations gave rise to the larger and very different mills just mentioned.

The annexed illustration represents one of these mills of moderate size, used for sawing lumber. Here the revolution of the dome is effected by levers projecting from the sides, and worked from the balcony at the top of the stationary portion. The sails are also adjusted from this balcony, their motion being stopped for the purpose by a brake, which is indicated in the figure, with a rope reaching down to the balcony.



Mill for sawing lumber.

Still larger mills are employed for raising water. The sectional view on the next page represents the system employed in Holland to drain the lakes.



Section of Holland Mill for raising water.

The mill simply turns a wheel, similar to the paddle-wheel of a st
boat, and immersed three or four feet in water, which it pushes forw

not raising it more than one or two feet, but displacing immense masses in a very short time. If water has to be raised, say sixteen feet, eight or ten such mills are placed at suitable distances along a long narrow channel, each feeding the next and each doing its share in lifting the water.

These are often immense structures, a hundred feet in height, and built of brick, on foundations prepared with especial precaution, by reason of the constant vibration to which they are subjected. The diameter at the bottom is about forty feet, and the walls are three or four feet thick, while at the top the diameter is some twenty feet, and the walls are thinner in proportion. The vertical shaft for the transmission of power extends through the whole height of the tower, and is placed exactly in the centre. The axis of revolution for the sails is supported by a dome, which revolves like the dome of an observatory, and the connection with the vertical shaft is made by means of bevel-gearing, so that the revolution of the dome does not disturb nor in any way affect the gearing for the transmission of power. The figure shows the balcony, with the lever arrangement attached above to the cap, and provided below with a windlass. The sails have been intentionally omitted in this engraving. Indeed, they always are furled in high winds, the surface of the beams being such that they may be driven without sails if the wind is strong enough. The figure also makes it evident how the cap and upper axis can be turned round without interfering with the operation of the mill, as the main shaft, transmitting the motion, stands in the middle of the structure. The free space in such a mill is occupied by lodgings for the attendants and their families. The working corps is much like that of a sailing-vessel, consisting of commander or foreman, first and second mates or assistants, carpenter or millwright, &c. The capacity of such a mill may exceed a hundred horse-power.

There are several principles and rules of experience to be observed in the construction of all large windmills. One concerns the inclination of the axis of revolution of the sails, which should not be perfectly horizontal, but inclined 10° or 15° above the horizon, observation having shown that the impulse of the wind is commonly exerted in a line descending at this angle.

Another principle of construction concerns the angle of the sails. The velocity of the wind being nearly uniform over the whole sail, while the rapidity of movement is much greater at the extremities of the latter, it is evident that the inclination of the sail should increase as the velocity of revolution increases. The best results are obtained when the inclinations to the line of the wind are nearly as follows: at $\frac{1}{6}$ the length of the wing from the centre, 70°; at $\frac{1}{3}$, 71°; at $\frac{1}{2}$, 72°; at $\frac{2}{3}$, 74°; at $\frac{5}{6}$, 77½°; at the end, 83°. Some authorities prescribe a scale of variations from 60° to 80°. According to Euler's mathematical calculations, the efficiency of the machine is greatest when the velocity of the extremity of the sail is twice that of the wind.

The following table presents approximately the effective total pressure of the wind per square foot upon the sails, at different velocities. From these figures the proper deductions must be made for the angle at which the wind meets the sail, and for the friction of the machinery, in order to obtain the amount of power available.*

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* See New American Cyclopædia, Vol. XVI, p. 468, Art. Windmills.

State of wind.	Velocity in feet per second.	Pressure per square foot on sails.
A low wind	3	0.0409
A low wind	6	0.1024
A moderate wind	9	0.2048
A moderate wind	12	0.4096
A moderate wind	15	0.6144
A fresh wind	18	0.8892
Best wind for wind-sails	21	1.2788
Best wind for wind-sails	24	1.6384
A good breeze for sailing vessels	27	2.0780
A good breeze for sailing vessels	30	2.5576
A stiff breeze	33	3.1920
A stiff breeze	36	3.8912

These figures show how great a power may be obtained by suitable machinery from the motion already provided by nature in localities where other sources of power seem to be lacking. The necessities of many such regions in this country should lead to the study on the part of engineers of the neglected, and perhaps despised, "old-fashioned Dutch mills."

PART V.

METALLURGICAL PROCESSES.

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CHAPTER LXXXIV.

GENERAL REMARKS.

quite generally believed by men of science abroad, and frequently ed by those who ought to know better at home, that we are blun- along in this country in the treatment of our gold and silver otally ignorant of the experience already gained in older coun- that somebody should be sent to Europe by our government to the methods of gold and silver metallurgy there employed, and ighten us with the results.

arge class of persons, on the other hand, scout the idea of all e from Europe, and point to the fact that we already surpass country in the world, unless it be Australia, in the completeness conomy of our gold-extraction, while all the imported processes hitherto failed.

truth lies between these extremes. American metallurgy is r wholly in advance nor wholly in the rear of the same science er nations. Out of our peculiar circumstances and conditions we developed some distinctively American processes with which e cannot compete, because the experience of Europe has not led perfection of such devices. Thus the hydraulic system of min- dapted to work cheaply large areas of auriferous earth, is native eculiar to this country, and is employed on a larger scale and in r perfection here than anywhere else. The California stamp-mill, ll its modern improvements, cannot be surpassed in the world for leteness of design and mechanical simplicity. Russia and Hun- cannot show such economical amalgamation as we do. Even in eatment of tailings and sulphurets, we have employed and im- d nearly all the European methods which our economical condi- will admit, and we have invented several of our own—such as the rocess, the Brückner cylinder, &c., which seem to be much more sing than the plan of the eminent Professor Rivot, which has re- dly failed among us, and never succeeded. Again, in the treat- of silver ores, the Washoe process of pan amalgamation is an out- h of American necessities, a hybrid from the arrastra and the patio, al with us, and not only remarkable in itself, but capable of modi- ons and applications which considerably diminish the realm of ing. The Freiberg barrel-amalgamation is indeed adopted in many ; but we have, in place of laborious roasting in reverberatories, ylinders of Brückner, and the shaft furnace of Stetefeldt, both ican inventions; that is to say, the product of foreign science, lated and directed by actual experience in this country. All the nces just given testify that we are not without an American metal- . Even now, it is necessary for foreign governments to send agents here to study our methods and report at home. We know the processes of Europe better than Europe knows ours.

But this American metallurgy which is springing up, is sadly desultory, incomplete, untrained, and unsystematized. Each step of progress costs more than it should. Thousands of experimenters waste their time in trying processes that have failed already, but of which they have no record. Many devices, even, that have been thoroughly tested and condemned in Europe spring up to enjoy a flourishing though brief career among our enterprising and ingenious people, not learned in their history. But many more originate among us, and, for want of harmonious action or organization among the mining interests, they are tried here and there, and the results of each trial smothered or magnified, so that it takes much more time and money than it ought to require to produce in the public mind the notion that a particular plan is beyond doubt good or bad. To furnish a nucleus of experience and an exchange of information, to settle many important points yet mooted in our incomplete American system, to consolidate and cheapen our progress, a national school of mines seems to me to be absolutely required.

The California stamp-mill process for gold is described in a number of well-known books, perhaps most completely in that of Mr. J. Arthur Phillips on Gold and Silver. It is admitted to be the best method thus far developed in actual practice on a large scale, for the treatment of auriferous quartz. The idea of smelting the ordinary auriferous quartz (even of low grade) has been put forward at different times by the possessors of patent fluxes; but its absurdity will appear if we reflect that every five dollars' worth of gold in a ton of quartz constitutes but one one-thousandth part of one per cent., or one one hundred-thousandth of the whole mass. To smelt auriferous quartz, therefore, is to flux and remove, practically, one hundred per cent. of quartz. The case is different when the barren material is not quartz, which needs a base before it will flux, and still more widely different where the ore contains some other useful metal beside gold, such as lead or copper, and where the gold, for some reason, escapes the stamp process. There is a field for smelting which may become important and extensive, but it never can supersede amalgamation.

This process, being principally mechanical, has been partially considered in a previous section. The causes of loss, and the direction in which greater perfection is to be desired and expected, will now be made subjects of brief comment.

Alleged losses of gold in stamp-mills may be divided into two classes. Either the gold is mysteriously lost, and cannot be subsequently traced, or it is to be found by assay in the tailings. In the former case, I am satisfied, after many observations, that the loss is generally only apparent, and may be referred to incorrect sampling or assay of the ore. An ordinary assay of gold ore, made previous to crushing, is not nearly so trustworthy as an assay of the tailings, properly selected. Hence, if the two, taken with the yield of amalgam, do not agree, the quartz assay is probably in error. Sometimes, however, batteries leak, and gold is lost under and around the mortars. Sometimes, on the other hand, workmen are dishonest, and charge losses upon the mill which their own peculations have occasioned. Occasionally, where the tailings do not settle in a quiet spot, but are hurried away in a swift stream, more or less fine gold is swept off before it can be deposited. Assays to test this question should, of course, be made with due precaution as to these points; but one thing our experience denies, viz, that there is any possible mysterious loss of gold in the stamp-mill process. The loss is mechanical, definite, always traceable, sometimes avoidable or curable, and never supernatural, as the arguments of some would almost tend to make us believe.

When the loss has been traced it is generally found to be due, apart from imperfections in the machinery, to the presence of fine gold, rusty gold, or pyrites, or to the flouring of the quicksilver. Floured or granulated quicksilver and fine particles of gold have, in common with some other polished metals, the property of condensing on their surfaces films of air, which decrease the specific gravity of the particle. As the amount of air, and hence the amount of decrease in specific gravity, is proportional to the surface exposed, and its ratio to the mass of the particle, and as the smallest particles expose always the largest proportional surfaces, (the cube roots of the volumes being as the square roots of the surfaces,) it follows that very fine particles will acquire a density less than that of water, and will, in fact, float upon it. Many more will be rendered so light as to settle very slowly. Perfect protection against this source of loss has yet to be found. The best expedients now known are to avoid that apparatus which tends excessively to flour the quicksilver, and to use sodium amalgam, cyanide of potassium, &c., to collect it when floured, though no mere chemical reaction will completely do this. With regard to the fine gold, it may be saved by careful manipulation, I am convinced, even in our present apparatus, to a greater extent than now. Of course, a swift current of water, escaping from the mill, must be avoided, if the gold is fine. Dry amalgamation has frequently been attempted, and never yet has succeeded. The use of quicksilver vapors is highly objectionable on account of their poisonous character. It is true that amalgamation can take place in tightly-closed retorts, but the regular discharging of these retorts, and, still more, their leaking, wearing out, or bursting, are perpetual sources of danger to health and life. The inhalation of the vapors of mercury, during experiments of this character, caused the twelve years' suffering and finally the lamented death of Dr. J. Adelberg, of New York, one of the most brilliant mining engineers and metallurgists of the country. He died a comparatively young man, after a gallant but ineffectual struggle against the poison that had taken insidious and unrelenting hold upon him; and the warning of his terrible, vain conflict, his sufferings and his premature death, should lead our metallurgists to beware of recklessly employing mercury in vapor form.

Rusty gold is apparently the result of the decomposition of auriferous sulphurets of iron. The greater part of the fine gold found in our ores has been in such association, and generally the oxidation of the pyrites by slow natural processes leaves the gold in amalgamable form, but sometimes a coating of iron oxide is formed over the particles of gold. This is also the case when sulphurets are artificially roasted. We may perhaps suppose that slow oxidation leaves clean gold, while quicker oxidation, whether natural or artificial, leaves rusty gold. Various devices have been employed to remove this inconvenience. The rusty gold will not readily amalgamate with mercury, and the slight contact afforded by copper plates is not sufficient for its treatment. Pans which grind the ore together with mercury are more efficient; but these produce so much fine gold and floured mercury that it is never well to use them first. The best manipulation is that which catches all coarse fine gold, if possible, in battery or on plates, and passes the pulp or blanket-washings into close amalgamators of various kinds, or into pans. Of this the Eureka mill, at Grass Valley, is a good example.

The treatment of sulphurets under the stamp-mill system has been a question of considerable difficulty. These are usually iron or copper pyrites, containing gold. The different practicable methods of treating them so as to secure the gold may be classified as follows. Concentration should in every case precede, where the amount of sulphuret is not large, in proportion to the gangue.

1. Natural decomposition by time.
2. Roasting and amalgamation.
3. Pan amalgamation with chemicals.
4. Smelting.
5. Chlorination.

Of these methods the first is the cheapest, but it is not equally practicable for all varieties of pyrites. Some pyrites decomposes very quickly when exposed to the weather, especially if it is from time to time drenched from a hose. In favorable localities the manufacture of copperas might be combined with the elimination of the sulphur in this way. After a suitable time the heaps of tailings could be again run through the mill, and a considerable quantity of gold extracted. This slow oxidation does not seem to produce rusty gold. In the Southern States, this simple expedient was quite common thirty or forty years ago, and I have heard of instances in which the second or third milling of gold ores produced as much gold as the first.

The plan of roasting the ore to remove sulphur, and then amalgamating it, seems quite rational, but it cannot yet be said to have succeeded. The roasting apparatus, invented in such abundance, has frequently been quite imperfect. In no other department of metallurgy have our inventors made such a brave show, with so little real success. Their plausible experiments turned on the fact that whatever is done to sulphurets, the first change produced is and must be a partial desulphurization. Hence the pyro-ligneous acid, the superheated steam, the cold bath, the hot bath, and numerous other fanciful inventions, comparing their results with the results of no process at all, could always claim to have desulphurized more or less of the original mineral.

But other and more scientific appliances seemed equally to fail. The reverberatory, the Gerstenhöfer terrace furnace, the Brückner cylinder, have all been tried on gold sulphurets in Colorado, though it is claimed that they have not been thoroughly tried, and that the practical success of the reverberatory and the cylinder in treating silver ores for amalgamation promises better results with gold ores than have yet been achieved. However this may be, the fact is strongly indicated by careful experiments in San Francisco, that the roasting of auriferous sulphurets produces rusty gold, which will not amalgamate. Mr. Brückner's experiments at Central City go to show that, by the addition of salt to the roasting charges toward the end of the process, the coating of iron oxide may by converted into a chloride and removed. This expedient would, I suppose, be impossible in the Gerstenhöfer, where the addition of salt would cause the ore to cake on the terraces. Whether the Stetefeldt furnace can be adapted to such a purpose remains to be seen. This is a subject still requiring investigation; and the essential problem is not to invent a new desulphurizer, as many suppose, but to find out whether desulphurized ores can be successfully amalgamated, and if so, how.

The system of pan amalgamation with chemicals is gradually gaining ground in California. The theory of the pan process, both for gold and silver ores, has been but little understood by those who, being skillful and practical mechanics, were, in spite of their ignorance of chemistry, our best mill-men. The use of chemicals, therefore, has been largely a matter of whim or superstition. But there is no doubt that chemical reactions, involving the decomposition of sulphurets, may be brought about in pans by using proper chemicals *in adequate quantity.* This has been done with decided success at the Empire mill, Grass Valley, where the cost of the treatment is estimated to be much lower than that of chlorination, and the results equally thorough. This is another direction in which quiet but highly important progress is to be expected.

Smelting is not to be employed except when base metals can be obtained as well as gold. It is one of the most complete, but at the same time one of the most expensive methods; and for a country like ours, it has the great inconvenience that it is a continual process, without pauses—in a word, without "clean-ups." It requires constant assays to control it. The only way to conduct it economically is to perpetually put back into each stage of the process certain classes of assorted semi-refuse; and thus the proceeds of each charge of ore are lost in the general average product of the works. It follows that custom-work, such as the mills perform, is impossible at furnaces. They must buy ores on assay, and take their chances as to profit. This combines mercantile with metallurgical risk, and it is often the case that the proprietor of the smelting works, to protect himself, puts his price list for ores so low as to drive away customers, or, to attract customers, pays so much for ores as to ruin himself. The only way to adapt smelting to our gold and silver industry is, in my opinion, to have smelting establishments under separate administration, abundantly supplied with capital, officered with the best skill in metallurgy and business, and supported by the purchase of various ores, which, by mixture, can be made to yield their valuable contents more economically than would be possible with the product of a single mine. The complete metallurgical and moderate financial success of Professor Hill in Colorado, is a comment upon this proposition.

Chlorination is a German process, invented by the celebrated Plattner, professor at Freiberg. It has, however, been considerably improved in this country, especially by Messrs. Küstel, Deetken and Hoffmann. It is the most thorough of all gold-extraction processes; but, in its ordinary application, it leaves the silver in an insoluble form in the ore. This could be extracted by subsequent leaching with hot brine, or the double-chlorination (a Hungarian process) could be employed, which gives a final solution containing the chlorides of both gold and silver. In most ores to which chlorination has been applied, however, the contents of silver are so small as to be overlooked.

The great cost and difficulty of the chlorination process lie in the preceding necessary roasting of the ore. This must be very carefully performed, and has thus far, I believe, required the reverberatory of one or more hearths. Of course there is much manual labor connected with such a furnace; and this, with the cost of chemicals, makes chlorination expensive. I suppose it will not pay to subject to it ores that contain less than $20 per ton, and in many places the price of treatment alone amounts to $25.

The amount of sulphurets extracted in gold ores, outside of Colorado, is thus far very small. When concentrated for special treatment, they do not amount to enough, at any one mine in the country, to keep a small chlorination apparatus continually running. The sulphurets of Colorado, however, constitute in many cases a great part of the ore. They are not disseminated sparsely in quartz; hence they cannot be easily concentrated to a high value. It seems to me, therefore, that for the average grade of Colorado sulphurets, natural decomposition, or the improved pan process with chemicals, affords at present the greatest promise. The former might be tried without much expense, as many mills have saved large heaps of tailings.

The losses in Colorado mills, the value of the tailings, and the original value of the average ore, have, however, been habitually overstated. The mills run very slowly, (more slowly, I think, than is necessary or advisable,) and manage to save a large proportion of the gold. Recently the object of mill-men seems to have been rather to reduce the value of tailings by perfecting the process in the mill. than to subject the latter to a second handling. The result is that most of the tailings contain enough gold to be an annoying loss, but not enough to pay for further treatment. I cannot help believing that this whole matter could be better adjusted in Colorado. The mill-men of that Territory must either admit that their ores are not so rich as has been represented, or that their extraction is inferior to that of other mining regions; that is to say, less perfectly adapted to the circumstances of the case. I would not see a blind imitation in Colorado of California or Nevada mills; but I would gladly see the Colorado mills as well suited to Colorado as the best California mills are to California. This will certainly come in time.

From the foregoing summary it may be seen how little Europe has to do with our present stand-point in the treatment of gold ores. What she can give us is the scientific spirit and training which will construct out of the abundant materials at hand an American art of gold metallurgy.

In the treatment of silver ores, America has given birth to two most important processes, the patio and the pan amalgamation. Of these, the former is not in use in the United States, experience having shown the climate, in most of our mining districts, to be unfavorable to it. There are some, however, who still think it might be in certain localities successfully employed. The pan amalgamation is the so-called Washoe process, and consists in passing the pulp from the stamp-batteries into pans, where it is stirred or ground, together with quicksilver, and sometimes with chemicals, especially copper, vitriol, and salt. This process has been considerably improved since the publication of Mr. Küstel's book, in which it is described, and a new and thorough publication on the subject would be very desirable. The practices of mill-men continue to differ widely, and many points of vital interest and importance remain as much unexplained as ever. Two improvements are, however, unquestionable. The first is the increase in the size of the pans; and the second is the adaptation of the Washoe process to refractory ores by means of chemicals in the pans. This is nominally by no means novel; nevertheless the successful application of bluestone and salt in the proper quantities to effect the decomposition and pan amalgamation of sulphurets, was only effected by the Brothers Janin within the last two years. (See my last report, p. 54.) The discovery is especially applicable to the slimes of the Comstock mills; but it may become important elsewhere.

The Freiberg process, as it is called in this country, consists in the roasting of refractory ores with salt and their subsequent amalgamation. The amalgamation is generally carried on in pans, whereas the true Freiberg method employs barrels. The dispute between the advocates of the two kinds of amalgamation is not yet settled. Further discussion of this and other points in the process will be found in the chapter on the Mettacom mill of Reese River district, where it is employed.

The manner of performing the preparatory chloridizing roasting is a matter of great importance. This is the most expensive part of the treatment, and the rapid disappearance of fuel in the silver-mining districts renders economy in that item highly desirable.

CHAPTER LXXXV.

THE REESE RIVER PROCESS—THE METTACOM MILL.

The best mills using the Reese River process of dry crushing, roasting, and amalgamation are probably the Manhattan, at Austin, and the Mettacom, in the same district, about a mile from Yankee Blade. The latter mill is in many respects unsurpassed in the country; and I was so impressed with the excellence of its general plan and arrangement, and with the skilful manner in which it was operated, when I examined it in 1868, that I have chosen it as the basis of a minute description and discussion. I am indebted for detailed information to Mr. John Howell, at that time superintendent, one of the most intelligent and experienced mill-men in Nevada.

The Mettacom mill was erected in 1865–'66 to work the ores of the mine of the same name belonging to the Mettacom Company, and owned, I believe, principally in New Jersey. Like all the narrow veins of the district, the Mettacom was not able to furnish ore enough to occupy the mill. In fact, though a great deal of rich ore has been from time to time obtained and reduced, regular and extensive stopes have never been opened; and the great cost of dead-work in shafts and drifts has doubtless exceeded all returns. For the year ending July 1, 1869, the mill has not made regular runs; but since that time it has been running on from the Lane and Fuller mine, on Lander Hill.

The mill contains ten stamps, in two batteries of five each. This number of stamps is generally considered to be the best. As the stamps at the end of a mortar do less work than the others, the more there are in one mortar the better the average work; but six would be too many, on account of the necessity of greatly increasing the diameter of the cam-shaft to prevent its springing. Many mill-men believe that five stamps, dropping in proper order, produce the best "wave" or "splash" of discharge through the screens; but this opinion refers only to wet crushing.

The weight of the stamps is nearly 900 pounds each. There is not so much difference of opinion now as formerly among good mill-men as to the proper weight for stamps. As the amount of horse-power (and hence of fuel) required to run a battery depends directly upon this weight, it has been necessary to find out by experience whether heavy blows do as much work in proportion as lighter ones, and where the proper medium lies. The question has quite as much to do with the discharge as with the crushing. The blow of the stamp not only pulverizes the rock, but drives it outward through the screens. In dry stamping this is the only force which effects the discharge. Hence the weight of the stamp should not be so great as to necessitate slow running. Probably 750 to 800 pounds is the best weight for general use; though, if all mills were run as skilfully as the Mettacom, even 900 pounds would not be too heavy.

The stems are 3⅛ inches in diameter. The usual size is 2⅞, and these stems are, therefore, nearly 20 per cent. stronger and heavier than ordinary; the proportion being as the squares of the diameters. The advantage of putting a larger proportion of the total weight into the stem is the diminished vibration from the blow on the tappet. The stems should always be fitted as closely as possible to the guides; but light stems spring or bend, and wear the guide in rising. There is no wear of this kind in falling, so long as the stem is true. The stems are set 8½ inches apart, the bosses and shoes work within about two inches of each other, and the distance between the tappets is about three-fourths of an inch. The whole length of each battery-mortar is therefore about 5 feet 6 inches.

The cam-shaft is rigged with single cams. The old fashion of triple cams is now about obsolete; but the usual form is the double cam, which many mill-men still prefer, claiming, that as it gives two drops of the stamp for each revolution, it saves friction in gearing, and enables the battery to be run at high speeds, without running the engine as fast. These and other arguments for the double cam only prove that it suits the machinery which has been calculated for it. As a matter of fact, however, I have never seen double-cam batteries equal the single cams in speed; and I think Mr. Howell is right in claiming the advantage for single cams, that the shoulder can be brought directly under the tappet, so as to prevent catching. With the ordinary double cam, the shaft must be set further back from the stems, and the cams are easily caught and broken.

This subject is directly related to the speed of the battery. The Mettacom mill has vindicated triumphantly the wisdom of its peculiar features by the most extraordinary running on record. For months together the batteries have been kept at from 98 to 100 drops per minute, rising to 102, or even 105, and never falling below 94; yet there has never been a cam broken in the mill. The Manhattan, an excellent mill, with double cams and stamps weighing only 750 pounds, cannot safely run on the same ore at higher speed than 85 to the minute, and Mr. Curtis, the able superintendent, with the performances of the Mettacom before his eyes, naturally declares himself in favor of the single cam, which would enable him to run his batteries up to 110 per minute. The Mettacom stamps fall 10 inches. The original drop was 9½ inches; but it was increased to ease the cams and give less jar. The rebound of the stamps amounts sometimes to 1½ inches. Strange to say, the high speed maintained has not caused excessive necessity of repairs. On the contrary the battery has stood the strain better than any other within my knowledge. Even the shoes and dies, which were not supposed to be unusually good, being bought for ordinary hard iron, lasted for five months of continuous running without being replaced. This fact cannot be adequately explained. Probably that particular set was a lucky cast. Ordinarily, it would have worn out in about six weeks; but I do not doubt that the heavy charges put through the batteries at high speed protected the shoes and dies from pounding on one another, which they are quite likely to do in ordinary mills, especially when the feeder is careless. A mill running at 100 to the minute keeps the feeder busy: and he does not wait for a stamp to thunder out, by pounding on its anvil, that it has finished its last mouthful and wants another.

A fact not to be overlooked in this connection is the great solidity of the battery frame and foundations. Nine-tenths of the stamp-mills ordinarily erected would rack themselves to pieces, if run as the Mettacom has been, without breaking so much as a bolt.

The gain in quantity of ore crushed is more than proportionate to the increase of speed. As I have remarked, this quantity depends, in dry-crushing especially, on the discharge. I shall speak of that presently.

as it regards the arrangement of screens; but I now refer to the frequency of the drops which supply the direct impulse and the air shock, by which the dry "pulp" is driven through the screens. Mr. Howell found by experiment that with 60 drops per minute he could put through in twenty-four hours only about 4½ tons; 90 drops gave a little over 10 tons; and 102 drops *more than 15½ tons.* If we assume that the increase in consumption of fuel would be the same as that in the power generated by the falling stamps per minute, we shall have:

No. of drops per minute.	Horse-power, per stamp.	Increase of power.	Yield.	Increase of yield.
60	1. 36	....	4½	....
90	2. 04	50 per cent..	10	122 per cent.
102	2. 22	10 per cent..	15½	55 per cent.

The increase of speed from 60 to 102, or 70 per cent., increased the yield from 4½ to 15½, or 244 per cent. To this should be added the gain in wages, interest on capital, &c., secured by rapid running. This comparison does not fairly apply to wet-crushing, though I am satisfied that in that process also high speeds are the best. But the difference is not so startling. Most wet-crushing mills come pretty near the average of 1¼ tons crushed in twenty-four hours per horse-power developed by each stamp. But the above table shows a variation from 0. 33 tons at 60 to 0. 70 at 102. The performance of the Manhattan mill is about 0. 45 tons crushed in twenty-four hours per horse-power developed by each stamp; and this is a fair, perhaps a high, average for such mills.

When the throat of the battery is open, the pulp will be thrown both ways, and some of it comes back on the feeding-floor. This indicates a fact too often ignored in the construction of mortars, namely, that since the impulse given by the stamp is radial in all directions, the greater the surface of discharge, the higher will be the duty performed. The Mettacom batteries are not perfect in this respect. They have only a single front discharge, but this is 18 inches high, instead of 12, as is usual. It is noticed that the fine pulp comes mostly through the upper six inches, and hence, in most batteries, would be thrown back into the mortar until it found exit below. Various forms of mortar with increased discharge have been recommended. The maximum discharge per stamp is attained by Clayton's circular mortar, containing only one stamp. There are also mortars with universal discharge, in which the screens go all the way round, being curved at the ends. The most common are the double dischargers, having screens in front and behind, and the feed over the rear screen. The objection hitherto made to all arrangements involving curved screens is the difficulty of properly stretching and keying them. In dry crushing, even a rear screen is found to be inconvenient on account of breakage from coarse ore. Mr. Curtis, of the Manhattan, however, prefers a double discharge, while Mr. Howell cares more for end-discharges. The Mettacom end-stamps are hung with three-eighths of an inch more fall than the others, and still do less work. The order in which the stamps fall varies in different mills, and for wet and dry crushing. The two extremes to be avoided are a simultaneous drop of all the stamps, which would rack the frame, strain the engine, destroy the continuity of discharge, and probably break the screens, and a drop in regular succession, (1, 2, 3, 4, 5,) which would shove the ore to one end of the mortar, and give the stamps at one end too much, and at the other end too little, to do. Some millmen prefer to arrange the succession so that no stamp shall immediately follow its next neighbor. The orders 1, 4, 2, 5, 3; 1, 3, 5, 2, 4; 4, 2, 5, 1, 3, would satisfy this condition. Others prefer dropping the two-end stamps first, as 1, 5, 2, 4, 3; or 1, 5, 4, 2, 3. The wave of discharge or splash of the water through the screens in wet-crushing is to be taken into consideration. In dry crushing, the objects to be secured are an equal distribution of ore under the stamps, giving an equal work per stamp, and a maximum discharge of pulp through the screens. The latter seems to be best secured by letting the middle stamp drop last. The outer stamps should then have slightly longer cams, to increase their fall. It will be found that the central stamps take and distribute nearly all the feed. Much depends on the skill and fidelity of the feeder, in both kinds of crushing. Hence the automatic self-feeding batteries used in Cornwall have found little favor in this country. They do not "humor" the stamps; and the difference in regularity of running and in duty performed, is more than equivalent to the wages of a good feeder.

The screens of this mill are No. 40, brass wire, (1,600 meshes to the square inch,) which is preferred for dry crushing to the "Russia punched." The latter are frequently preferred by mill-men in wet crushing, on account of alleged greater durability, or in the belief that slits are better adapted to discharge liquid pulp than meshes. I take leave to doubt, however, whether these advantages in any case counterbalance the greater proportional discharge-area offered by wire screens. The Mettacom screens are not vertical, but lean outward about 10 degrees. The pulp generally goes through obliquely, and is as fine as the siftings of a horizontal No. 60 sieve. The angle given has been established as the best for dry crushing. The gain in amount of discharge, wet or dry, from inclined screens, is universally recognized; but mill-men do not so generally bear in mind that the screen so set should be a little coarser than the fineness required for the pulp, if the best results are to be obtained. Mr. Howell's observation is that stamps ordinarily crush faster than the batteries discharge. He has often put the pulp back through his battery, and found it took about as long to go through as fresh rock. Running slow gives the fine dust a chance to fall back under the stamps; running fast keeps it constantly in motion, and much of it gets out. I venture to suggest some considerations based upon the foregoing facts, and calculated, I think, to put mill-men upon the right track in increasing the efficiency of dry batteries. It seems to me that dropping 900-pound stamps is a costly way of making currents of air to promote discharge. The object of the mill-man should be to get the highest practicable speed from his stamps, and then to give them such facilities for discharge as that every drop shall do its full work in crushing. The increase of the discharge area is the first and most obvious means, and a useful auxiliary will, I think, be found in producing a current of air with a fan, which shall suck or drive the fine dust through the sieve. I have seen exhausting fans applied in this way in several mills. There was one in the Sheba, at Star City, Humboldt County, and there were several in the early Austin mills, which were finally condemned. Mill-men are too ready to reject such appliances as soon as they cause a little trouble, whether through faulty construction or careless management. But this point will be found too important to be dismissed so easily. I do not remember ever in my life seeing a stamp mill in which the difficulty of discharge did not really delay the work of crushing. The extreme of excessive discharge, which would do no harm, is carefully avoided, and no one can tell to this day, how much the stamp now in se could be made to do, by simply improving batteries in this respect. he tide of invention is, it appears to me, running the wrong way. We ave innumerable devices to increase the force and efficiency of the blow f the stamp, which is already in advance of the rest of the machinery, hile the inventions for improving the mortars and discharges are few, enerally imperfect, and regarded with too little favor by those practial mill-men who are alone competent to take hold of them and perfect hem.

The screens at this mill last nearly four weeks. When the threads wear thin they begin to shift, and the screens must be removed. They re turned to prolong the wear. The middle of the screen lasts longest. The dies, when new, come up to within about one inch of the lowest portion of the discharge. It is very important to make this interval, alled the "height of issue," as small as the screens will bear. The dies used for five months wore away about 1½ inches, and the introduction of new ones raised the capacity of the battery nearly two tons er day. Much trouble was experienced in keeping the dies in their laces in the bottom of the mortar. Finally 150 pounds of melted lead was poured in, filling the mortar-bed about one inch. This is found to work well. I think that for dry crushing a single die, filling the whole ed, would be better yet. When it wears on one side it can be turned, nd so used till it is worn out. This is a German plan, and used successfully in some dry-crushing mills managed by Germans in this country.

The foundation of a battery is the most important part of its construction, and it is the feature most neglected in this country. Few mill wners like to put so much money "out of sight;" the work of preparing foundations is parsimoniously, ignorantly, or carelessly managed; nd the result is that the batteries cannot be run at high speed, and even at low speed they are continually settling, or getting out of line. he great efficiency and stability of the Mettacom mill is due to its carefully-prepared foundation. The mortar-blocks are set on end, upon solid ed-rock. They are nine feet deep. Before placing them the rock was horoughly smoothed and levelled, and the bottom of each block was laned true. The upper ends of the blocks being (as is the case with ll large timbers) sun-cracked, melted sulphur was poured into the cracks. The mortars are set on the blocks and screwed down tight. If crewed (as is frequently the case) directly to the blocks, they will in a few months get loose, and rock and sand will work between, putting he machinery out of plumb and endangering the mortar. To prevent his, two thicknesses of blanket soaked in tar were put between the mortars and the blocks. An arrangement was made by which the setting of the mortars could be measured. It is found that, after more han a year of steady running, they have sunk uniformly less than one-fourth inch—doubtless due to the compression of the blankets. The freeom from jar in the mill, while the batteries were running at tremendous peed, impressed me as decisive proof of the utility of the arrangements escribed. There is, however, some vibration in the cam-shaft, which hould have been five inches instead of four in diameter. Mr. Howell ecommends also heavier bearings. The latter are now eight inches, and hould be ten. No Babbitt metal is used in the upper box; it cannot e kept in, and smooth iron is therefore preferred. The battery, running at 98 to 100 per minute, requires about twenty-two horse-power, which is perhaps a little more than half the power employed in the mill, nd crushes easily seven tons in twelve hours. This being about the sual duty for twenty-four hours, the rest of the mill, especially the reverberatories for roasting, calculated on that basis, cannot come up to the capacity of the battery; and this great defect in the original plans has never yet been remedied. I have frequently found mills in which the capacity of the roasting or amalgamating apparatus is quite unsuited to that of the batteries. In such cases the extra machinery is practically good for nothing, since the capacity of a mill is determined by its least adequate part. The Mettacom batteries must either run but twelve hours daily, or they must run for a longer period at full capacity, and then stand still until the surplus of pulp has been roasted.

The roasting department is also very expensive. It compares unfavorably in this respect with some other mills on the same plan, to say nothing of the difference between all reverberatories and the Stetefeldt chloridizing furnace. The pulp from the batteries is deprived of all moisture by drying with heat from the roasters. Of these there are four, in the English style. They have 84 square feet each of stirring surface, and very low arches. I will not pause here to discuss the proper form for reverberatories to be used in this process, as they are likely to be soon superseded altogether. The shape most common in Central Nevada was adopted at hap-hazard, and the excessive lowness of arch frequently met with is doubtless a defect, as it brings the reducing influences of the flame too closely upon the body of the ore. The building is wide enough for stirring and for cooling floors. Contracted mill-buildings are not economical. They embarrass workmen, especially at the furnaces, and increase the expense of handling ore. Salt is charged with the ore, and during the process, to the amount of 10 per cent. The roasting charge is 1,000 pounds, and a complete operation requires about seven hours. The four furnaces treat, on an average, 6½ tons of ore daily, each consuming one cord of wood, and all four requiring the labor of twelve men.

Amalgamation is performed in "Freiberg barrels." The question of superiority between barrels and pans has not yet been definitely settled, and probably the true answer will differ with circumstances. The pan is virtually an American invention; American workmen are more familiar with its use, and American manufacturers are greatly interested in maintaining it. Moreover, the pan is a part of the Washoe process, in which most of our silver-mill men were primarily trained, and for which it appears to be well fitted. On the other hand, I do not think that barrels have had a fair trial. All inconveniences which attend them can be measured in money, and may possibly be more than compensated by the cheapness and incomparably smaller expense of repairs or renewals, involved in the use of barrels. The barrel works for 10 tons per day will cost:

6 barrels, at $200	$1,200
3 settlers, at $180	540
Gearing and machinery	300
Total, exclusive of power	2,040

The economy of the process, as conducted at the Mettacom mill, is satisfactory. There are ten barrels, 5 feet by 4 in the clear, taking each one ton at a charge, and making 16½ revolutions per minute. The quantity of quicksilver employed varies with the value of the ore. For $200 ore, 400 pounds of quicksilver are kept in each barrel. As the wood of the barrel remains neutral, it is necessary to keep iron scraps in the barrels to effect the required reactions. For this purpose, about 200 pounds of wrought-iron (much better than cast iron) are put in each barrel when the works are started, and the quantity is maintained by replenishment as fast as it is consumed. The pulp from the roasters, in which the silver has been chloridized, is mixed with hot water to the consistency of a thin curd, and introduced into the barrels through the large square bungs, which are tightly closed, and the barrels set in revolution. For two hours no quicksilver is added. During this period the iron absorbs the excess of chlorine from the ore. After this, the iron looks bright; the quicksilver is added, and in about three hours amalgamation is in full progress. The revolution is continued over eight hours longer, when cold water is added till the barrel is full; the barrel is revolved fifteen minutes, and finally discharged into a settler. The duration of the amalgamation for one ton is therefore about fourteen hours. There are two barrels to each settler. The settlers have 6 feet diameter and 3 feet depth. They are provided with wooden arms, revolving about 2 inches from the bottom. The collection, retorting, &c., are performed in the usual manner.

The barrel staves are at first six inches thick. They are now worn in places about 1¾ inches. The present barrels cost $200 each, and have been running four and a half months. They may be counted good without repairs for four months longer, when they can be mended, at a nominal cost, by lagging them up inside, so as to make them in reality last an indefinite time. They are run with friction wheels, and consume less than two horse-power each. The bullion from pans is generally finer, and melts with less dross and slag. But the results of these barrels, in point of amount of silver extracted, as compared with the assay, are equal, I think, to those of pans.

The power for driving stamps, barrels, settlers, &c., is furnished by an engine of about 60 horse-power, run at 40 to 45; steam pressure, 55 to 60 pounds. Steam is supplied by two 16-feet tubular boilers, 44 inches in diameter, and containing 42 tubes each. The steam cylinder has 14 inches diameter and 30 inches stroke. There is an 18-feet fly-wheel, weighing 4,500 pounds.

The following statements show the cost of the different operations:

ACTUAL COST OF POWER.

2 engineers, $6 and $5 50 per day	$11 50
4¾ cords of wood, at $10	47 50
Repairs and oil	5 00
Cost of power, per day	64 00

COST OF CRUSHING,

Power, (batteries require about half the power)	$32 00
2 men to break rock and feed, $4 50 and $4	8 50
1 man to clean battery and help them	4 00
Average daily repairs	3 00
Total daily expense of batteries	47 50
Average daily crushing, 13 tons; cost per ton	3 65

COST OF ROASTING.

11 men, at $4	$44 00
1 foreman, at $5 50	5 50

4 cords of wood, at $10	$40 00
Salt, 10 per cent. on 6½ tons, 0.65 tons, at $45	29 25
1 cooler, (also employed at the barrels, charge half-time,) at $4	2 00
Repairs and incidentals	8 00
Total daily expense of furnaces	128 75
Average roasting per day, 6½ tons; cost per ton	19 80

(The cost at the Manhattan is said to be only $15.)

COST OF AMALGAMATION.

Power, (half the power of engine)	$32 00
Old wrought iron, 100 pounds daily, at $2 50	2 50
3½ men, at $4	14 00
Loss of quicksilver, 2 pounds per ton	13 20
Repairs	2 00
Light and oil	2 00
Total daily expense of barrels	65 70
Average daily amalgamated, 10 tons; cost per ton,	6 57

RECAPITULATION.

	Per ton.
Cost of crushing	$3 65
Cost of roasting	19 80
Cost of amalgamating	6 57
Retorting and melting	1 00
Total cost of treatment	31 02

The cost of treatment of chloride ore, unroasted, would be:

	Per ton.
Crushing, about	$3 50
Amalgamating	6 57
Retorting and melting	75
Total	10 82

The Mettacom Mill could be in several particulars considerably improved; but, taken as a whole, I do not know of any other that can surpass the record of efficiency and economy thus furnished by the actual averages of prolonged working. If the Mettacom reverberatories were as good as those of the Manhattan, the cost of treatment, including roasting, would be only $26 22. The use of the Stetefeldt furnace would probably reduce it to $21 22. These figures are thus proved not to be mere wild theory; and the mining industry of Central Nevada will not thrive until they are put in practice.

The superiority of the Mettacom batteries led the proprietors of the Lane & Fuller mine, at Austin, to lease this mill, and finally, I believe, to purchase it, though there were, at the same time, half a dozen standing idle nearer to their mine. A success so marked deserves even more detailed examination than I have given it. But I hope I have said enough to arrest the attention and arouse the emulation of practical experts, for whom, chiefly, this chapter has been written.

CHAPTER LXXXVI.

NEW LEACHING AND CHLORINATION PROCESS FOR SILVER ORES.

BY GUIDO KÜSTEL.

Leaching and chlorination are two different processes, not applied heretofore to silver ores in the manner or combination here described.

THE LEACHING PROCESS.

Leaching of silver ores is by no means a new invention. Augustin, Patera, and Ziervogel have employed it in their respective processes. Neither of these three processes, however, was ever successfully introduced in the United States. The pan amalgamation, in consideration of its undisputed advantages in many respects, remained master of the field. The pan amalgamation is divided into two distinct methods, one including, and the other excluding, the preliminary roasting of the ores. The question of the best results from the direct amalgamation of raw, unroasted ore, is still a matter of diligent investigation. In the treatment of the Comstock silver ore (its contents in gold being left out of question) less than sixty per cent. of silver is in most cases extracted by the present pan amalgamation. Other kinds of ores of a refractory nature yield a still smaller percentage, if amalgamated directly in pans. Hence the numerous investigations and experiments, in spite of which, since the beginning of the pan amalgamation—that is to say, after nearly ten years spent in crushing millions of tons of silver ores, though the inventive genius of numerous most skillful mill-men has been concentrated on the attempt to discover a better way of treating silver ores without roasting—not one single chemical has yet been found to operate more effectively for the decomposition of sulphurets than the old Mexican "*magistral*" or blue-stone (copper vitriol) and salt, which amounts to the same thing as "chloride of copper." The reason of the persevering attempts to discover a "chemical," is, of course, the desire to avoid the expense of roasting. This same consideration prevailed for hundreds of years also in Europe. No chemical was discovered there either. There appears, therefore, to be no very great risk in predicting that after the lapse of another decade the amalgamation of unroasted ores in pans will be found about on the same footing as it is at present. All that can be expected are periodical excitements over some new inventions, which will prove to be old and die out again, as did the late "amalgamation by means of electricity."

The only real meritorious process in treating raw stuff in pans is that adopted by Messrs. Louis and Henry Janin, which consists simply in the administration of a larger percentage of blue vitriol. The practical proof, however, is confined as yet to the "slums" or "slimes" of the Comstock ore, from which, by this means, over eighty per cent. of the silver has been extracted. But if the silver ores of the same class as those from which the slimes were obtained should be treated with, say, one per cent. of blue-stone, the resulting amalgam would contain too much copper for practical economical results.

The use of blue-stone and salt involves, first, the formation of chloride of copper, which is reduced in presence of quicksilver into sub-chloride of copper; and by this the greater part of the silver sulphurets is decomposed. But this process does not always give the expected results, as there are many silver combinations which resist the action of the blue-stone entirely. Especially is this the case with argentiferous zinc blende, plumbiferous ore, some kinds of argentiferous copper ores, &c. Carboniferous silver ores, and such as contain the silver in oxidized condition, (for instance, stetefeldtite or partzite)* seem to yield a larger percentage of silver (70 to 75 per cent.) if treated directly in pans by amalgamation with the aid of blue-stone and salt, (or sulphuric acid and salt, provided there is copper oxide in the ore.) In many cases, however, there is still trouble on account of too much copper getting into the amalgam.

Another ingredient applied to raw ore in pans is the cyanide of potassium. This chemical keeps the surface of the quicksilver clean, and this is its most valuable property; for, as a decomposer of sulphurets, at least in pans, it is inferior to the chloride of copper. Where other chemicals are used, the cyanide should be introduced at the end of amalgamation, in order to assist the gathering of the quicksilver globules into a mass. If used together with blue-stone and salt, there is not the slightest benefit derived from the cyanide, as it forms immediately a combination with the copper.

As there are no soluble metallic salts in raw ore, *leaching* is only applicable after *roasting*. For eight or nine years past, refractory silver ores have been roasted and amalgamated in pans, with variable success. The most satisfactory results have been obtained where the mill-men were lucky enough to treat such ore as contained only a small percentage of base metals; but a series of difficulties was encountered in operating on ores presenting a considerable amount of antimony, copper, lead, or arsenic, and in working tailings which required roasting. It was found that the pan amalgamation, like that in wooden barrels, but in a still greater degree, produces, under such circumstances, a very low bullion, from 300 to 500 fine. This, however, is not all; the loss of quicksilver in some cases amounts to from eight to nine pounds per ton of ore; and the pans themselves were destroyed in from nine to twelve months, so that many mills in the Reese River country, for instance, used wooden sides to the pans on this account. As a natural consequence of the amalgamation of so much base metal, the extraction of silver was greatly obstructed, and a smaller percentage of silver was obtained. Another and more serious difficulty with some kinds of refractory ore, was the disproportionate amount of iron which came into the amalgam. In such cases, after several experiments, roasting and amalgamation in pans was generally given up, as it was impossible to separate the iron from the silver in a simple way. Such amalgam contained from thirty to eighty per cent. of iron after retorting. By some mill-men it was pulverized and subjected to a second amalgamation, from which clean amalgam resulted. Others dissolved the iron in diluted sulphuric acid, leaving the silver ready to be melted into a bar. The retorted amalgam was also introduced into crucibles and melted; but only a part of the silver separated, leaving lumps of rich metallic iron which could not be brought into a liquid state. It is not explained as yet under what peculiar circumstances this iron amalgam is formed, nor is it possible to point out with certainty the ores which are liable to yield such amalgam. I have observed only that antimony and arsenic, besides some copper, are always present when iron amalgam is formed, but it does not follow that this amalgam is always obtained from ores containing the above base metals. Many mills treating refractory ores suffered severely by the appearance of iron amalgam, but the general influence of the base metals, as mentioned before, was more sensible.

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* I question whether these minerals contain oxide of silver, though the other metals in them, such as antimony, copper, and iron, are certainly oxidized. This point has, however, in my opinion, nothing to do with the metallurgical behavior of the minerals, as stated by Mr. Küstel in the text.—R. W. R.

It is strange that, simple as is the remedy against the unwelcome interference of base metals, so many years of operation were allowed to pass by without making use of it. It was the dogma of all metallurgists, that in order to make base metals less injurious during amalgamation in barrels or pans, their respective chlorides had to be destroyed during roasting, either by an increased heat or by the addition of lime or ashes. Superheated steam was also applied for the purpose of destroying the salts of the base metals. But none of these devices for the elimination of the base chlorides were satisfactory. It was known that most of those chlorides are, as the chloride of silver is not, soluble in water. These facts led me to the conclusion that, instead of increasing the heat and lengthening the roasting process for many hours, and thus effecting only a part of the desired result, it were more simple and thoroughly efficacious to remove the soluble chlorides of base metals, after roasting and before amalgamation, by leaching with hot or cold water. My first experiment with this method in practice was made in San Francisco, on the ore of the Rising Star mine, of Flint District, Idaho. Of a well mixed and roasted lot, two portions, each of fifty pounds, were weighed out and amalgamated in pans, one portion having been previously leached. The resulting amalgam was retorted and melted. The bar of the leached ore had a fineness of 900, while the other formed a clumsy lump of metallic iron containing silver.

There is certainly another way yet, not only to obviate the iron amalgam, but also to obtain a cleaner bullion, without leaching. This is, to grind the roasted ore in iron pans or otherwise, and to amalgamate it in wooden tubs, barrels, or stone arrastras, keeping all iron or copper out of the amalgamators. The consumption of quicksilver will be very heavy, and the yield of silver undoubtedly less than when the ore is amalgamated in iron pans after leaching.

The Leaching process, as executed in Flint with the silver ores from Rising Star mine, (now stopped for want of ore,) is as follows: The Rising Star ore is composed of argentiferous gray copper, rich in silver, miargyrite, some ruby silver, zinc blende, galena, iron pyrites, and sulphide of antimony. After being reduced to powder by dry crushing in batteries with an addition of five per cent. of salt, or one hundred pounds to the ton, the ore is conveyed by means of endless screws and elevators to mechanical roasting furnaces, (O'Hara's.) Including the cooling and feeding hearth, the furnace is one hundred feet long by three feet wide. An endless chain, to which two iron flat rings with plows are attached, moves slowly through the furnace, pushing the ore by degrees forward at the rate in which the constant feeding from the batteries goes on. The furnace has three fire-places, by which its whole length is kept red-hot. It is about six hours before the ore, in a glowing and well-roasted condition, appears at the discharge end of the furnace. (About ten tons of the same kind of ore was roasted equally well in common roasting furnaces at Dall's Mill, Washoe Valley.)

Sampling of the ore.—It is of great importance to ascertain the value of the ore before and after roasting. The first forms the basis of all calculations of loss. The difference between the values of the unroasted and the roasted ore gives the loss sustained in roasting, provided the weight of the ore does not change, as is the case with the Rising Star ore. The value of the bullion obtained from a known number of tons, compared with the assay value of the same amount of tons, shows what percentage of silver was saved by the process. The "argumentum ad hominem," that is, the bar in hand, is the only real proof of success. The comparison of other assays will demonstrate in what part of the manipulation the heaviest loss occurs. The knowledge of the value of tailings, after the amalgamation is finished, is very important, and should never be neglected. It is the daily indicator of metallurgical progress. The mode of taking samples for the assays is not immaterial. On its correctness depends the whole calculation. The best way of taking samples in raw amalgamation is to charge the pans with the ore and to take from each several ounces, after about two hours' grinding, before the quicksilver is introduced. This, however, is not practicable with ore subjected to roasting. At Flint, every hour, day and night, by means of a little shovel, from different points of the hearth of each furnace on the feeding side, samples, amounting to one or two pounds, were taken from the raw ore, (containing five per cent. of salt,) and in the same way also from the roasted ore on the discharge side. From these collected samples average samples were taken every morning and delivered to the assay office. From the amalgamating pans the ore and quicksilver is discharged into settlers, from which, after several hours, the tailings are drawn off, first through an upper, and then through a lower, plug-hole. At each discharge a pailful was taken from the upper and another from the lower hole, and the slime allowed to settle for several hours. From the accumulation of twenty-four hours, in this manner, a true average was reserved once a day for an assay. This mode of taking tailing samples is not exactly the most proper. Mr. Henry Janin's way, though more troublesome, is also more correct. The tailing sample is not taken from the settler, but from the amalgamating pan, shortly before the discharge. A few ounces are very carefully washed over into a clean pan or dish, so as to retain all quicksilver and amalgam. From the washed-off tailings the clear water is poured off, and the residue dried and assayed. For ores treated by the leaching process these tailing assays have, however, no value, on account of the sometimes great quantity of chlorides of iron, copper, and other metals which are extracted by the leaching, unless this loss by leaching is ascertained first on a weighed sample by an experiment and the rectification made accordingly on the assay sample.

Examination of the roasted ore as to the amount of chloride of silver formed during the roasting: If ninety per cent. of silver are obtained from the amalgamation of the ore, as compared with the assay of the roasted ore, it is a proof of a thorough roasting, but it is no proof of the economy of the work. On the other hand, if only sixty or seventy per cent. should result, it is not easy to say where the fault is to be looked after. It may be due to the roasting or to the amalgamation. It is, therefore, important to know how much of the silver contained in the ore is converted into a chloride, and also when the chlorination is finished, otherwise the roasting might continue half an hour or an hour longer than necessary.

For the purpose of finding the amount of chloride of silver in the ore, it is sufficient to take two half-ounce assays of the roasted ore, well weighed, and one of them prepared in the usual way for a fire assay, while the other is placed in a carefully folded filter in a glass funnel. The filter must project over the ore about one inch; a warm dilute solution of hyposulphite of soda (more convenient than ammonia) is then poured over the ore, and the filtering is continued until no precipitate is obtained by adding a few drops of sulphide of sodium to the filtered liquid. Hot water is then introduced, in order to wash out the hyposulphite of soda, and the ore with the filter dried in a porcelain dish. The filter paper, when dry, can be burned above the dish, so as not to lose any of the ashes. The dried sample is then fluxed, as is the other half ounce, and both crucibles are exposed to a smelting heat. The resulting argentiferous lead buttons are cupelled, the silver buttons are weighed, and the difference shows the amount of chloride of silver. If there should be any sulphate of silver in the roasted ore, it would be included by this test as a chloride. It might be separated by using hot water before the hyposulphite of soda; but for practical purposes this is not necessary. To illustrate the calculation by an example, we may suppose, for instance, that No. 1 assayed 83 oz. per ton, and No. 2 from the filter 4 oz. The difference, 79 oz., is the proportion which became chloridized, or 95 per cent. of the 83 oz.

After the ore has been discharged from the roasting furnace it is ready to be leached. This process ought to be performed as far from the stamps as possible, in order to prevent the settling of the ore in the leaching boxes by vibration. At Flint the length of the O'Hara furnaces was quite sufficient to avoid this evil. The leaching boxes were placed not far from the discharge of the furnaces, over 100 feet from the stamps. Each box is 18 inches high, 7½ by 6 feet in the clear. Four inches of the space at the bottom is filled with small pieces of rock, covered with a piece of canvas, forming thus a false bottom to permit filtration. Close at the bottom is a hole containing a short piece of one-inch rubber hose, through which the leach is led into wooden troughs.

The ore is introduced into the boxes to within four or five inches from the top. A stream of hot water is then allowed to flow in. When the box appears full, the water-cock is shut off so much as to regulate the in and out flow, keeping the box always full. The leach which comes out through the hose at the bottom contains a great amount of dissolved metallic chlorides, and yields a thick precipitate if a solution of sulphide of sodium is added. These chlorides, having always a small portion of undecomposed salt in solution with them, dissolve some chloride of silver, (¾ to 2 per cent.) It is, therefore, advisable to conduct the leach through a long zigzag trough, where the chlorides of lead and antimony, including the silver, precipitate by themselves. It should be remarked that the use of hot water is advantageous for two reasons: First, it dissolves the chlorides more easily than cold water; and, secondly, what is more important, the filtering of fine pulverized ore is easy with hot water, but too slow with cold water to make a practical use of it.

After two or three hours (depending on the quantity of base metals) the leach, when tested with sulphide of sodium, shows only a slight precipitate, whereupon the water is shut off. It takes yet from one-half to three-quarters of an hour before all the water runs through. The ore still retains too much water. If it were taken out as soon as no more water issues through the pipe at the bottom, it would not only be very inconvenient to transport to the amalgamating pans, but many mill-men would consider the pulp too dilute even for the pan. For this reason the ore must be cut by means of a shovel, thrust simply through the mass down to the filter, at short intervals, over the whole surface. The water begins immediately to run out again. This operation may be repeated once more; and, so drained, the leached ore is now ready to be moved on cars over to the amalgamating pans.

The amalgamation of the leached ore is now a very simple process. Nearly all the iron chloride, a great deal of lead and antimony, and all the chloride of copper, are removed. The amalgam, nevertheless, will always contain more or less copper. This is due to the formation of sub-chloride of copper (Cu Cl) during the roasting. This salt is not soluble in water, and hence remains in the ore; but in the pan it is easily decomposed by the metallic iron and amalgamated. As in ordinary amalgamation, the ore must be ground for two or three hours before the quicksilver is added. The pulp should be kept thick, as it then allows the quicksilver to remain in larger globules; but the whole mass must be kept in lively motion. From the time the quicksilver is introduced, the muller should be raised, as there is no grinding required during the amalgamation. It would only cause a heavier loss of quicksilver without giving a better result, provided sufficient grinding was done beforehand. The case seems to be different with unroasted ore. At Flint the ore was subjected to grinding for three hours, and an equal time was allowed for amalgamation. The temperature is kept nearly at the boiling point by introducing steam. With roasted ore a high temperature is not necessary; it promotes too much the parting of the quicksilver, and to some degree, also, its evaporation.

After six hours, quicksilver and ore are discharged into settlers, and the amalgam is obtained in the usual way.

The leaching process is applicable also to the gold-bearing sulphurets, especially in the presence of copper, which, without leaching, interferes with the amalgamation of gold.

The chlorination process.—This was first applied to silver ores by Küstel & Hoffmann. The chlorination itself does not differ from Plattner's chlorination of gold-bearing sulphurets. Although the extraction of silver and gold separately is more perfect than pan amalgamation, the resulting metal finer and the process cheaper, there are at present two reasons that pan amalgamation is preferred. While the amalgam is obtained in five or six hours from the pan amalgamation, by a treatment which is the simplest of all metallurgical operations, the chlorination process requires 24 hours' time and more attention. Time and simplicity are the considerations. The chlorination process dispenses with the quicksilver, with the power for amalgamation, with the heavy investment for amalgamating pans and settlers, but it dispenses also with the superintendency of carpenters and engineers, a pet institution of most silver mining companies. The chlorination process is not, in reality, complicated. This objection is imaginary, and arises from ignorance of the process.

In almost all cases the silver ore must be subjected to roasting before being treated by chlorination. There are instances, however, where the ore can be chloridized direct from the batteries. So, for instance, the silver ore from the Mount Tenabo mine, Nevada, the stetefeldite and partzite, and all oxidized ores free of sulphur. The silver ores of La Dura mine and the tailings of Trinidad mine in Sonora, treated by the chlorination process, are roasted with the addition of four per cent. of salt. Oxidizing roasting, however, is preferable in most instances, especially where no regard is paid to the extraction of copper. This is lost by an oxidizing roasting; but the silver comes out purer. No subsequent chloridizing roasting is necessary.

The roasted ore is introduced into tubs or boxes with a false bottom, like the leaching boxes described above; but it is important that the ore should be moistened before charging, only so much as to make it damp. In this state the ore is decomposed or attacked more perfectly by the chlorine than if it were dry. The vat is then covered and closed air-tight by a few bolts and India-rubber lining, and the chlorine gas is admitted through a pipe under the false bottom. By using over again the surplus chlorine, the La Dura ore requires for the production of lorine 8 pounds of sulphuric acid, 4 pounds of manganese, and 4 ounds of salt, per ton of ore. The time when the box is filled with lorine is easily observed at a little hole in the cover, left open for that rpose. The chlorine may be detected either by the smell, or, better, ammonia brought before the hole, which creates white fumes in conct with chlorine. This hole is then closed and the ore allowed to reain with the chlorine gas for 12 hours. The silver, which is in the ate of an oxide, or sulphate, is converted into chloride, as is also some on and copper. Some of the oxidized ores, if chloridized without asting, yield a great amount of chloride of iron. According to the ore or less perfect roasting, there will be found more or less chlorine the box after 12 hours' rest. This surplus of gas is utilized again by awing it over into another already charged box. At La Dura this is fected by injecting water, which forces the gas into the next box rough an India-rubber hose. This must be done with hot water, since ld water would absorb too much chlorine. The gas can be drawn er also by a soaking arrangement. All of the soluble base metal lorides must be extracted first by hot water, as described in the leachg process. Two things, however, have to be considered in this first aching. If, on account of the copper, the ore has been roasted with lt, or if, besides the copper, some gold was contained in the ore, e water will dissolve and carry out both the gold and the copper lorides. The solution is conveyed into a tank, and the gold precipited by sulphate of iron. After several hours, when all the gold has ttled to the bottom, the clear solution is drawn off again into another t, containing metallic iron scraps, for the precipitation of the copper.

After all soluble salts have been extracted by leaching with hot ater, the remaining chloride of silver must be dissolved and leached t by hyposulphite of soda, or, better, by hyposulphite of lime, and en precipitated by the respective sulphides. The precipitate of sulhide of silver obtained by sulphide of calcium is easier to wash and to ress than that from sulphide of sodium. Where lime is to be found, e hyposulphite and sulphide can be made at small expense in the mill. ne pound of burned lime and 1.35 pounds of sulphur give a solution of lphide of calcium that will precipitate about one and a half pounds of lver. The hyposulphite of lime once produced will serve for years, as ore than the wastage is replaced by the use of the sulphide of calcium, hich turns into hyposulphite. Of the diluted hyposulphite of soda or me, (cold,) so much is conveyed into the box containing the ore as to aintain a constant flow from below the false bottom. The leach has a ery sweet taste if silver is dissolved in it. It is conveyed into a tank, d the silver precipitated by addition of a sulphide. No more of the lphide should be used than the exact quantity necessary to precipitate e silver. This is important, because, after the precipitation, the soluon is pumped out and used again on the ore. If, then, a surplus of e precipitant were in the hyposulphite, it would precipitate silver hile in the ore, and so much less silver would be obtained. On the her hand, when not all the silver in the leach is precipitated by the lphide, no trouble results. It takes, however, only a little practice to able the operator to neutralize the solution with ease. After the sulhide has been added, the solution must be brought into rapid motion some kind of a stirrer. The sulphide of silver separates quickly om the clear liquid. More sulphide of sodium is added; and if it observed that the precipitate appears whitish, it is a proof that early all the silver is precipitated. This sign is, however, obtained ly from the use of a polysulphide of sodium or calcium.

The precipitated sulphide of silver is brought into canvas bags or filters, and leached with warm or cold water in order to remove the hyposulphite of soda. The washing is still more important when hyposulphite of lime serves for the extraction. The precipitate is placed under a heavy press to get rid of as much water as possible, and then dried in a reverberatory furnace. When dry, the heat is a little increased, whereby the sulphur ignites and burns off in a few hours. After this, the silver is ready to be melted in a crucible with addition of some scrap iron, without other fluxes. The iron takes up the sulphur left with the silver, and forms a matt, which contains some silver, and is returned to the ore.

Mr. Ottocar Hofmann, who introduced this process in La Dura, Mexico, uses iron retorts for the desulphurization of the silver sulphide, for the purpose of regaining the sulphur, which serves again to prepare the sulphide.

Stetefeldite and other oxidized silver ores, after being chloridized and leached, without being roasted, may be amalgamated in pans if preferred.

CHAPTER LXXXVII.

BRÜCKNER'S PROCESS FOR CHLORIDIZING SILVER ORE.

This process has been successfully introduced into the silver districts of Colorado, and a large percentage of all the silver produced in that Territory during the last three years has been extracted by its use. The process has lately been so much improved that it offers decided advantages over the old plan of roasting and reverberatory furnaces. The expenses for labor and fuel are thereby very considerably reduced, and the roasting is done to greater perfection and in a shorter time than in the reverberatory. One man can at a time attend to from six to eight of the furnaces by which the process is performed.

Brückner's furnace consists of a cylinder of boiler iron, lined in a durable way with strongly braced brick-work, and made to revolve between a fire-box and a flue; from the fire-box the flame and air pass through a pipe into the cylinder, and from there, together with the gases produced in roasting, into the condensing chambers, from which the latter escapes through a smoke-stack.

A diaphragm made of cast-iron pipes is set at an angle of about fifteen degrees to the axis of revolution, and extends diagonally through nearly the whole length of the cylinder, for the purpose of moving the ore from end to end of the cylinder, thereby exposing it to the action of heat and atmospheric air in a very uniform manner, and performing mechanically the work of transferring the ore from the cooler parts (nearest to the flue) to the hotter, (nearest to the fire bridge,) and *vice versa*, which labor, by the old process, has to be performed by hand once every hour.

As the partition does not pass through the whole length of the cylinder, the latter is provided at each end with several flanges, set at an angle of about forty-five degrees, for the purpose of conveying the ore within the reach of the diaphragm.

The operation of the cylinder may be learned by any person in a few days, and is as follows: A charge of 3,000 pounds of silver ore, and 150 to 300 pounds of salt, is introduced through a man-hole into the cylinder, (the inside of which has previously been heated to red heat,) the opening closed, some more fuel thrown into the fire-box, and the cylinder made to revolve at one-half to one revolution per minute. The fire in the fire-box is so regulated that after one hour's time the sulphur contained in the ore commences to burn. Then the fire is so regulated that the ore is kept all the time at a dark red heat, gradually increasing to red heat. Very little fuel (and in ores containing much sulphur no fuel at all) is required until most of the sulphur has been oxidized; but then some more fuel is added in order to gradually increase the temperature of the ore pulp to an intense red heat. The pulp soon assumes a spongy, "woolly" consistency, in consequence of the mutual decomposition of the sulphates (formed in roasting) and salt, (chloride of sodium,) and of the chlorine gas being evolved; and after one hour's time, or as soon as a sample taken from the furnace evolves pure chlorine, and no sulphurous smell can be perceived any more, the chloridizing roasting is completed. Then the man-hole plate is removed, and while the cylinder is kept revolving the ore is made to drop through a grate into a screw conveyor, which conveys it through an iron trough kept cool from the outside by water. By this mechanical contrivance, the formerly so expensive, tedious, and unhealthy process of cooling the ore on a large cooling floor is done away with, and is performed to perfection, and without any additional labor, within fifteen minutes' time, since the ore by this process is by machinery directly carried into the screen and the hopper ready for further treatment.

Besides the last-named improvements, the inventor has also made some additional improvements for the purpose of increasing the working capacity of the cylinders, and to prevent at the same time all losses resulting from fine particles of ore and volatile chlorides from being carried off by the draught. It must be borne in mind that the greater the quantity of atmospheric air which comes into contact with the heated ore the quicker the roasting process is performed.

The arrangement consists in the use of a steam suction pipe set (in the direction of the draught) into the flue between the cylinders and the condensing chambers; said pipe being arranged in such a manner that the draught through the furnace is considerably increased, and all volatile matter condensed and collected at the bottom of the chambers provided for this purpose.

This furnace can be used for roasting any kind of refractory silver ore; also for desulphurizing auriferous pyrites previous to chlorination or smelting; for roasting ores of zinc, lead, copper, &c.; also for burning cement, and for the manufacture of soda from cryolite.

Particular pains have been taken to construct every part of the improved cylinder strong and solid, and in such a manner that all interruption of the working of the mill on account of any part getting out of order is avoided as much as possible.

Additional particulars concerning this apparatus are given in section 8, of this report, under the head of Colorado.

CHAPTER LXXXVIII.

THE STETEFELDT FURNACE.

This invention is one of the most important steps of progress yet achieved in our American silver metallurgy; and its direct effects in stimulating the production of bullion, by reducing its cost, will be felt immediately. Already the mines of many a half-abandoned district are augmented in value and importance by the mere announcement of its success.

The following description of the Stetefeldt furnace is from the notes of the inventor himself, and from the records of actual experience at Twin River, Reno, &c.:

Since the discovery and exploration of the numberless mineral deposits in the Western States and Territories, no branch in metallurgy has received so much attention as the process of roasting ores of all descriptions. One can hardly look over a file of mining journals, or newspapers from some mining district, without finding descriptions of new devices for roasting ores, all of which claim to surpass everything else in this line which was known before. The devices are as strange as they are many, and much time and money has been wasted to test impracticable inventions. Indeed, the high expense which the roasting in the old reverberatory furnace entails was a strong inducement to invent some cheaper, and at the same time more effective, method. This is especially of importance where silver ores are found which require a chloridizing roasting preparatory to their amalgamation. In such cases the expense of roasting is frequently more than one-half of the total expense of reduction, and consequently low-grade ores cannot be worked with a profit. But in spite of the necessity to adopt some improved and more economical process of roasting, it has been extremely difficult to introduce two inventions, which are based upon the most simple and rational principles—so simple, indeed, that it seems impossible to simplify them any more. I refer to the Gerstenhöfer, or Terrace, furnace, first introduced about six years ago at Freiberg, and the Stetefeldt furnace, invented three years ago at Austin, Nevada, but first introduced for regular working at the mill of the Nevada Silver Mining Company, near Reno, Nevada, in October of last year. The nature of these inventions can be expressed as follows:

Gerstenhöfer discovered that sulphurets are completely roasted or oxidized if they fall against a current of hot air rising in a shaft, which is filled with shelves, so as to check and retard the fall of the ore particles at certain intervals.

Stetefeldt discovered that silver ores, no matter in what combination the silver occurs, mixed with salt are completely chloridized if they fall against a current of hot air, rising in a shaft with no obstructions whatever to check or retard the fall of the ore particles.

It is a matter of course that in both cases a certain degree of fineness is required for the ore to be treated, and that a much coarser material can be successfully roasted in the Gerstenhöfer furnace than in Stetefeldt's.

I do not intend to enter here into a detailed description of the Gerstenhöfer furnace, since that invention has been frequently laid before the public in several mining papers; but I will merely compare it with the Stetefeldt furnace, and point out the distinctions of the two inventions.

As a cheap chloridizing roasting is a vital question for the industry of silver mining in this country, it is evident that Stetefeldt's discovery far surpasses that of Gerstenhöfer in importance. But the question arises whether the former, as constructed by Gerstenhöfer, cannot be used as well for chloridizing as for desulphurizing roasting. Experience answers, No.

In the Gerstenhöfer furnace only such ores can be successfully treated which, at a red heat during roasting, have no tendency to sinter or stick together. But the small particles of a charge of ore mixed with salt are exactly in such a condition while roasting as to have the greatest possible inclination to sinter and adhere to the shelves. They would thus soon obstruct the whole shaft, and prevent any further work. This has been demonstrated by actual experiments on a working scale. It is apparent, therefore, that the application of the Gerstenhöfer furnace, even for desulphurizing purposes, is very limited, and that certain classes of ore must be entirely excluded from it. This is especially the case with galena ores, which are the most expensive to roast in reverberatory furnaces.

In Stetefeldt's opinion, the shelves in the Gerstenhöfer furnace are perfectly superfluous, and all ores, even galena, can be desulphurized by dropping them through a plain shaft heated by fire-places below, if they are reduced to a sufficient degree of fineness. The escape of unroasted dust from the shaft is of no consequence, as a separate fire-place is constructed for the roasting of these suspended particles in the Stetefeldt furnace. Furthermore, the feeding machinery of the Stetefeldt furnace is based upon a principle entirely differing from that used with the Gerstenhöfer furnace.

That a furnace without shelves is cheaper and easier to construct, more durable, less liable to get out of order, and that it requires less labor and skill to run it, must be conceded by everybody.

Much difficulty was experienced to provide suitable feeding machinery for the Stetefeldt furnace. Gerstenhöfer's apparatus, consisting of fluted rollers, which force the ore through slits in the top of the furnace, would not answer at all. The ore fell down in lumps, and arrived at the bottom of the shaft almost raw. The reason for this behavior is simply the tendency of the particles of all finely-pulverized mineral substances to adhere to each other if a slightly compressed mass of them falls through the air. It is, therefore, necessary to introduce the ore pulp so finely divided, that all the particles can be penetrated by the heat within the short time of their fall through the shaft. To feed the pulp with a blower, as it is done in Keith's desulphurizing furnace, was not considered desirable for the following reasons:

1. The fall of the ore would be accelerated.
2. The draft of the fire-places would be impeded by the downward current of the air from the blower.
3. The formation of dust would be considerably increased.

The feeding machinery in its present shape can be briefly described as follows:

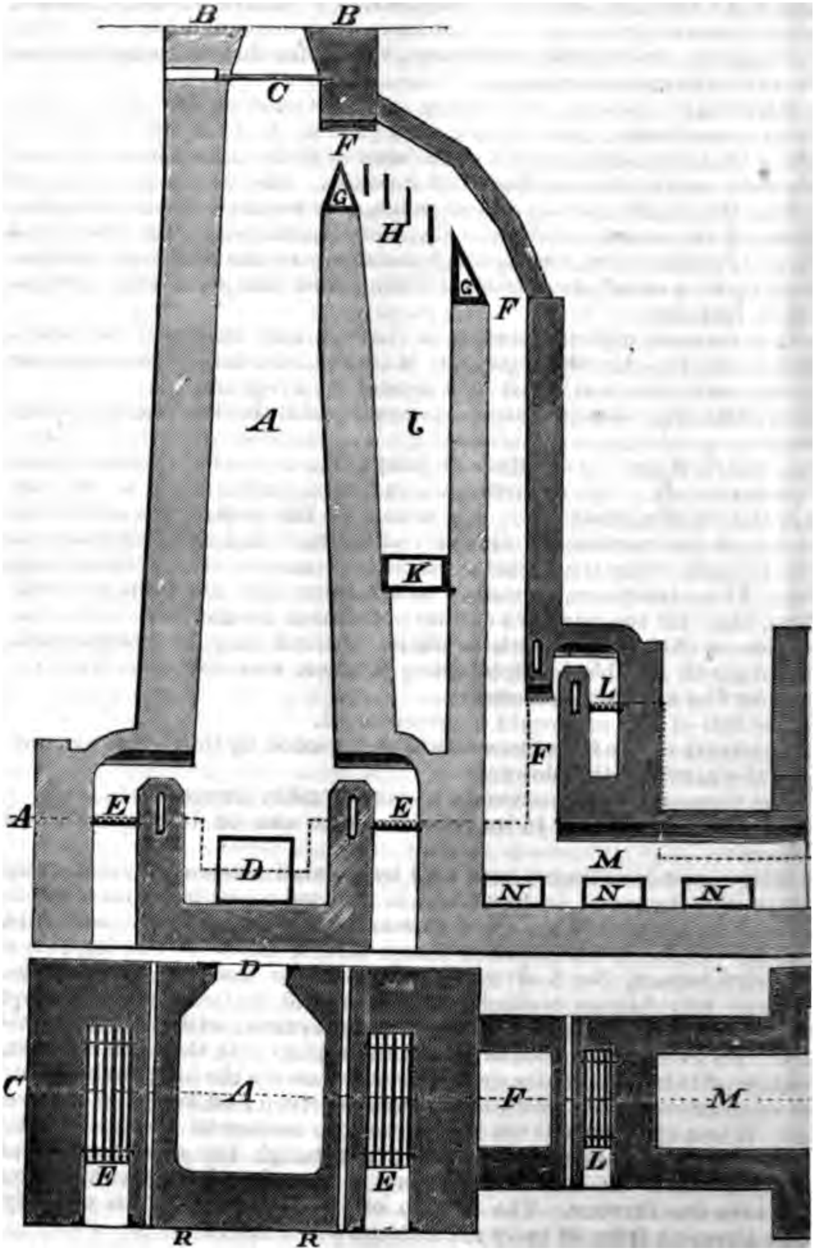
A hollow cast-iron frame, kept cool by a small stream of water, rests on top of the furnace. In this frame is inserted a cast-iron grate, which is covered by a punched screen of Russia iron, No. 0, for wet crushing, of the trade. Close to the punched screen moves, inside of the hopper, a coarse wire screen, No. 3 of the trade, which is fastened to a frame. The frame has flanges resting upon adjustable friction rollers outside of the hopper, and receives its motion from a crank, with 1⅜-inch eccentricity. To avoid the motion of a stratum of pulp with the coarse screen, a number of thin iron blades are so arranged across the hopper that their lower edges reach close down to the coarse screen and keep the pulp in place. When the crank is set in motion, the meshes of the coarse wire screen cut through the pulp, and drive it through the openings of the punched screen. In this way the ore is introduced in a continuous stream into the furnace. The motion of the crank-shaft was variably tried in Reno at from 30 to 70 revolutions per minute.

Construction of the furnace at Reno.—The accompanying drawing give a correct idea of the construction of the furnace at Reno:

A, shaft through which the ore falls.

B, top of shaft upon which the feeding machine is arranged.

C, damper, which is inserted when the screens of the feeding ma ery are exchanged.



The Stetefeldt Furnace.

D, door through which the roasted ore is discharged upon the cooling floor.

E, fire-place.

F, flue through which the gases escape near the top of the shaft.

G, triangular flue-bridges, of cast-iron.

H, grate of cast-iron plates, forming the bottom of flue F, allowing the dust, a small part of which settles here, to drop into the chamber I.

K, discharge door.

L, fire-place which heats the lower part of flue F, and roasts the dust.

M, canal connecting with dust-chamber.

N, discharge door.

O, dust-chamber.

The main dust-chamber of the furnace at Reno is 24 feet long, 8 feet wide, and 10 feet high. From there the gases pass under a dry kiln, 39 feet long and 7 feet wide. The two flues under the dry kiln are 3 feet wide and 4 feet high. A flue, 3 feet 4 inches wide and 4 feet 6 inches high, and about 180 feet long, leads from the dry kiln to an iron chimney of 2 feet 6 inches diameter on a hill-side. The top of the chimney rises about 40 feet above the top of the furnace.

The fire-places and arches are built of the best fire-brick, the rest of common brick. All the walls are built double, with a space between. The furnace is well anchored with iron rails and ⅞-inch rods.

The following changes are contemplated in the construction of the furnace:

1. The use of oxide of carbon as fuel; the gas to be made out of charcoal in generators. The construction adopted for the latter will be similar to that of the copper-refining furnace at Mansfeld, Prussia. In this way a much more uniform heat can be obtained than by using wood, and labor will be saved, as the generators have to be charged only every three or four hours. Where wood must be hauled a considerable distance, charcoal will be even a cheaper fuel than wood.

2. The chamber I will be abandoned, and the flue F brought down directly on the side, R R, (see ground plan,) of the shaft.

3. A more extensive system of dust-chambers will be connected with the furnace.

Manipulation.—The ore is mixed with the necessary amount of salt on the dry kiln, and crushed by a dry crushing battery through a No. 40 wire screen. A conveyor takes the pulp to a revolving screen, to keep out coarse particles, which may be caused by the breaking of a battery screen. The screened pulp is then taken by an elevator to the top of the furnace and discharged into a bin, which keeps the hopper of the feeding machine filled.

The fire is kept in all the fire-places as uniform as possible, and such a degree of heat is maintained that the roasted ore at the bottom of the shaft is red-hot, but does not sinter or stick together. The ore is discharged when a charge of 1,000 pounds to a ton has accumulated, and cooled in the usual manner. At the same time, roasted ore is discharged through the door N, where most of the dust settles, which is roasted by the fire-place L.

Chemical process in the Stetefeldt furnace.—Küstel describes the chemical proceedings of the chlorination in the Stetefeldt furnace as follows:

"At the first glance, it would seem that, considering the short time of two seconds, in which the falling ore is exposed to the flame, a perfect chlorination could not take place, especially if compared with the known facts apparent in the common roasting furnace—that is, that sulphurous acid is first formed under influence of a dark-red heat, by aid of the oxygen of the air, while the metal, deprived of its sulphur, becomes an oxide. The oxygen of the air and of the oxide act on the sulphurous acid, converting it into sulphuric acid, which again combines with the metal oxide to a sulphate. The sulphate reacts now on the salt, setting the chlorine free, and the formation of chlorides begins.

"This reaction and transformation requires time, which is not offered in Stetefeldt's furnace, but the chlorination is effected nevertheless, and very perfectly, with less salt and in a few seconds. The chemical action in Stetefeldt's furnace is as follows: As soon as the ore enters the furnace each sulphuret particle ignites, being surrounded by a glowing atmosphere, evolving at the same time sulphur, which, in presence of atmospheric air entering undecomposed through the grates, is converted into sulphurous acid, and the metal into an oxide. In contact with ore particles and oxygen the sulphurous acid becomes sulphuric acid. This acid does not combine with the metal oxide to a sulphate, as is the case in a common furnace; or if so, only to an insignificant degree, on account of the temperature, which, nearly from the start, is too high. The sulphuric acid, therefore, turns its force directly against the glowing salt particles, setting free the chlorine. All these reactions are, so to say, in *statu nascenti*. From the burning fuel steam is present among the gases, giving rise to the formation of hydrochloric acid. This hydrochloric acid not only originates directly by decomposition of the salt, but also from the chlorides of the base metals, which are formed in the upper part of the furnace, and again decomposed to oxides and hydrochloric acid in passing through the hot flame. The whole space of the furnace is then filled with glowing gases of chlorine, hydrochloric acid, sulphuric acid, sulphurous acid, oxygen, steam and volatile base metal chlorides; all of them acting on the sulphurets and oxides with great energy. The chlorine decomposes the sulphurets directly, forming chloride of metal and chloride of sulphur. It decomposes and combines also with oxides and sulphates. The hydrochloric acid does the same. The sulphuric acid decomposes the salt and oxidizes the sulphurets, while the oxygen creates sulphurous and sulphuric acid and oxides. The red-hot ore falls down, and, accumulating, continues evolving gases of chlorine, &c.

"Considering now a minute particle of ore (for only as such, not as a mass, can the ore be considered in falling) in a red-hot state being attacked contemporaneously by all those gases which have free access from all sides: the principle of the Stetefeldt furnace is, that the chloridizing result must be effected before the particle reaches the floor. The dust which passes the flame of the small fire-place is even in a better condition for chlorination, being surrounded and acted upon longer by all the chloridizing gases which are formed in the main shaft."

Practical results of the Stetefeldt furnace in chlorination.—A great number of tests were made during the first weeks of running the furnace at Reno. Between 88 and 92½ per cent. of the silver contained in the ore was found to be chloridized, all of which is easily extracted in amalgamation. The roasted dust discharged through the door N is generally one per cent. better chloridized than the ore discharged from the main shaft. With an improved system of firing, the chlorination should never be less than 90, and we have no doubt that much higher figures will be obtained. Only very skilled roasters achieve such results in the reverberatory furnace. With ordinary care, a charge cannot be burned in the Stetefeldt furnace, and the roasted pulp is in a splendid condition for barrel amalgamation, as it contains no lumps or sintered matter. Ores of the most various characters have been roasted with equal success. Even ore containing nothing but silver-bearing galena was treated without any difficulty. In this respect the furnace is admirably adapted to roast ores with large amounts of antimonial and lead-bearing minerals.

Amount of salt.—In reverberatory furnaces ten per cent. of salt is generally used. This amount may be safely reduced to six per cent. for very rich ores, and to three and four per cent. for low grade ores, in the Stetefeldt furnace. No experiments have as yet been made to determine if this percentage can be reduced still more. The difference in the percentage necessary is explained by the fact that in the Stetefeldt furnace all the salt is decomposed and utilized, while in the reverberatory furnace a large percentage remains in lumps and entirely unchanged.

Fuel.—The amount of fuel necessary to heat the shaft depends very much upon the character of the ore. The more sulphurets an ore contains the less fuel is required to roast it. The furnace in Reno uses on an average about two cords in twenty-four hours. With this amount between 12 and 15 tons of ore are roasted daily, which is as much as the battery crushes. But the same fuel would just as well roast 20 tons of mainly sulphuret ores, which increase the heat in the shaft when introduced in larger quantities. How many bushels of charcoal a furnace with gas generators would require we are not able to estimate reliably at present; but for most localities in Nevada charcoal will be as cheap if not cheaper than wood.

Labor.—At the mill in Reno eight men are employed to run the furnace. Of these three are firemen, three discharge and cool the roasted ore, and two watch the feeding and elevating machinery. If gas generation with charcoal is used, the labor of three men can be saved, and the two men who watch the feeding machinery can very well charge the generator shafts. In this way only five men will be required to run the furnace. Taking these facts in consideration, it is easy to estimate how much the Stetefeldt furnace cheapens the expense of roasting. In a mill of 20 tons capacity, in twenty-four hours, at least ten reverberatory furnaces would be required. The labor needed in twenty-four hours is, 2 carmen, 2 pulp-coolers, 2 oremen, 30 roasters; total, 36 men; fuel, at least 10 cords of wood in twenty-four hours; salt, 10 per cent. or 4,000 pounds. In the Stetefeldt furnace these 20 tons are roasted with 8 men, (or 5 men if charcoal is used as fuel,) 2 cords of wood, and 2,000 pounds of salt; saving by use of Stetefeldt furnace, every twenty-four hours, 28 men, (now, and 31 men with charcoal furnaces,) 8 cords of wood, 2,000 pounds of salt. Besides this, the original cost of the Stetefeldt furnace is less than that of a corresponding number in capacity of reverberatory furnaces. It requires less repairing and does better work. I may mention, furthermore, an experiment made in Reno to try the capacity of the furnace. One ton of pulp was accumulated and put through the furnace in thirty minutes, indicating the furnace to have a capacity of 48 tons in twenty-four hours. Ninety-one per cent. of the roasted ore was found to be chloridized.

CHAPTER LXXXIX.

ELECTRICITY APPLIED TO METALLURGY.

The following article from the San Francisco *Mining and Scientific Press* of May 22, 1869, gives an account of various so-called electric, or electro-magnetic processes for the reduction of ores. On the practicability of such methods I must decline to express an opinion. As I have already hinted in speaking of the supposed effects of electricity in ore deposits,* there is no particular distinction between electrical reactions, in which a metal is reduced, at the cost of a chemical decomposition and so-called ordinary chemical precipitates. The precipitation of copper from solution by means of metallic iron and its galvanic deposition in electroplating, are both according to chemical equivalents. Indeed, electrical decompositions have given the foundation for the modern system of chemical equivalents. A good many so-called galvanic or electric metallurgical effects, such as the reactions of sodium amalgam, of magistral in the patio, and of vitriol and salt in the pan amalgamation, might as well be called chemical. The use of the more obscure name only misleads the practical operator, who, believing in some mysterious catalytic influence, does not employ sufficient quantities of his reagents, and obtains, in consequence, imperfect results. The convertibility of chemical activity into galvanic currents does not, it seems to me, offer any theoretical gain in economy. The consumption of chemicals is still necessary. But the case is different when magneto-electric machines are used. These promise at least a conversion of mechanical force into chemical activity, and the question whether this conversion would be practically profitable is well worthy of consideration. Mechanical force can be gained in so many ways, and applied to so many other purposes, that its auxiliary use in this respect might become, under some circumstances, a great economy. I am not very sanguine as to its present application; but the idea deserves mention, if only as a new and ingenious deduction from the modern theory of the correlations of force. The following is the article referred to:

"The working of ores of silver and other metals by the aid of electricity was probably first proposed by Professor Bequerel, who devoted a number of years to experimenting on the subject, without attaining, however, any really practical results, so far as concerned economy. According to his plan the ores were first subjected to roasting, in order to convert the metals to be extracted—which were mostly in the state of sulphurets—into chlorides and sulphates. These products were then dissolved, the former in a solution of chloride of sodium, and the latter in water, whereupon the liquids thus obtained were respectively placed in vessels containing plates of copper, tinned iron, or prepared carbon, which served as negative electrodes, and porous cups filled with a solution of chloride of sodium, and containing the positive metal, consisting of pieces of either zinc, iron, or lead were introduced to complete the voltaic combination. To establish the electric circuit the negative electrode of one apparatus was then, by means of a wire or otherwise, brought in metallic contact with the positive electrode of the other, &c., and upon the last connection being made the reduction of the metals held in solution ensued. This process, which was especially intended for the beneficiating of silver ore, was finally abandoned because the percentage of metal obtained from the ore was far less than that yielded by the Freiberg process of amalgamation, with which it also compared unfavorably regarding expense.

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* Part III, Chap. LXII of this report.

"This whole subject assumed a new phase when, about ten years ago, the first attempts were made in this country to apply the electric current directly to the ore without previous reasting. These attempts were probably suggested by the property possessed by metallic sulphurets of conducting electricity. If in a solution of chloride of sodium sulphurets of silver are brought in contact with the positive electrode of a galvanic battery, they are decomposed, chloride of silver is formed and dissolved, and from it metallic silver is thrown down upon the negative electrode. This process is materially aided by the presence of chloride of copper, produced either by the mutual decomposition of sulphate of copper and chloride of sodium, or by the electrolytic action between a solution of chloride of sodium and a positive electrode of copper.

"It seems Mr. John Scott, of San Francisco, was the first who undertook a series of trials to test the practicability of subjecting silver ores, plunged in a solution of chloride of sodium and salts of copper, to the action of voltaic electricity. Others, more or less conscious of the object and the scientific principles involved, stepped from time to time in his wake, failed, and returned to their legitimate callings, until several months ago public attention was anew, and in a higher degree than ever before, drawn to the subject by an exhibition of experiments on an extensive scale by Messrs. A. L. Nolf and F. L. A. Pioche. Their process, as publicly shown, is substantially as follows: They immerse the ore, finely pulverized, in a solution of chloride of sodium and sulphate of copper contained in a wooden vat, the inner sides of which are, to within six or eight inches from the bottom, lined with sheet copper. In the center of the vat is an upright shaft, to which arms or stirrers are attached, which are also covered with sheet copper, and extend downward far enough to be in contact with a layer of quicksilver resting on the bottom. This quicksilver, and through it the arms or stirrers, are connected with the negative pole of a powerful galvanic battery, while the copper lining of the vat is connected with the positive pole. To allow the introduction of steam, the vat is provided with a well-fitting cover. During the operation the shaft is revolved by power derived from a small steam-engine, and thus the ore pulp is kept in agitation, so that the particles of sulphurets contained therein may successively be thrown in contact with the positive electrode, in order to become decomposed.

"Now it must be borne in mind that in the application of electricity to the treatment of ores containing sulphurets, and such other metalliferous minerals as must be decomposed before their constituent elements can combine to salts capable of forming electrolytes, from which metals may be reduced, it is a necessary condition for the success of the operation that each particle of such minerals be not only *brought* in contact with the positive electrode, but also *kept* in contact with the same until it is decomposed.

"This condition, it is evident, cannot be complied with by a mere agitation of the ore pulp between electrodes placed vertically, or otherwise so arranged that a contact between each particle of sulphuret and the positive pole-plate is in great measure but a matter of chance, and generally of but momentary duration; unless the operation be continued for an indefinite length of time—or, indeed, the chemical ingredients added to the ore pulp be of such kind and quantity that the intended result would almost as well be reached without the application of electricity.

"An invention by Dr. A. F. W. Partz, of Oakland, for which a United

States patent has lately been granted, is intended to meet the requirement above referred to, and thereby render practicable a new metallurgical process which may yet be destined to play a conspicuous part in our mining industry. The apparatus which he employs may be briefly described as follows:

"A cylindrical wooden vessel, about 6 feet long and 4 feet in diameter, a segment of which, amounting to nearly one-third of its periphery, is missing, is horizontally so suspended on two gudgeons fastened to its sides in the line of its axis that the opening left by the missing segment is on top. This opening is provided with lids which are closed during the operation. Lengthwise through one of the gudgeons is bored a hole, just wide enough to allow a steam pipe, which in the vessel is bent downward, to pass through it and remain in place when the gudgeon is turned. The bearings in which the gudgeons rest are supported by pieces of timber, between which thick plates of glass are inserted, to prevent loss of electricity by "leakage." The inner periphery of the vessel is, up to the height of its axis, lined with a sheet of copper, which forms the positive electrode, and is, by means of wire which passes through the side of the vessel, brought in metallic connection with one of the gudgeons. Eight or ten inches from the periphery, below the axis of the vessel and parallel with the same, a number of tubes of brass or copper about two inches in diameter are placed in a segmental row a few inches from each other, resting at one end of the vessel upon a wooden, and at the other upon a metallic support. These tubes constitute the negative electrode, and are, by means of a wire attached to the metallic support, and which passes through the side of the vessel, brought in metallic connection with the other gudgeon. Upon either gudgeon rests the end of a flat spring, and to these springs the respective poles-wire of a galvanic battery, or some other generator of dynamic electricity, are fastened.

"Having thus given an outline of the principal features of the apparatus, we will proceed to give a brief description of the manner in which argentiferous ores are worked by its means.

"The cylindrical vessel is, to about one-third of its capacity, filled with a solution of chloride of sodium, to which pulverized ore is added until the mass forms an easily-flowing pulp. By power applied to a crank fastened vertically upon one of the gudgeons, the vessel is put in a slow swinging motion, the crank alternately deflecting from 40 to 50 degrees either way from its vertical position. This motion is intended to prevent the earthy portion of the ore from settling, and at the same time to facilitate the sinking of all heavier particles, (sulphurets, &c.,) and their concentration upon the positive pole-plate, where they collect in a layer, which is kept agitated just enough to insure the constant forming of new points of contact with the pole-plate. The electric connection being made as above stated, and steam being turned on, a vigorous electrolytic action ensues. Water and chloride of sodium are decomposed, oxygen and chlorine are disengaged at the positive electrode, and ready to enter into the new combinations they effect, under the influence of the electro-current, the decomposition of the sulphurets and other metalliferous compounds resting upon the positive pole-plate, while they also attack the plate itself, forming with the material thereof oxychloride of copper, which in turn aids in the formation of chloride of silver. The latter dissolves in the solution of chloride of sodium present, and from it metallic silver is reduced and deposited upon the tubes constituting the negative electrode. As the silver thus reduced is apt to be in a loose, flocculent, or spongy state, the tubes must be amalgamated with mercury to better insure its adhesion and collection, and the amalgamation must from time to time be renewed, which may be accomplished by merely dropping some mercury into the vessel; because on coming in contact with the positive pole-plate the mercury is dissolved, whereupon it is reduced again to its metallic state, and deposited together with the silver. The form of tubes was chosen for the negative electrode on account of the large surface which they afford, and the facility with which they are removed and stripped of the adhering amalgam. If, under circumstances, it should, however, be deemed preferable to employ a layer of quicksilver in their stead, the same may be placed in a flat vessel, the negative pole-wire dipped into it, and the vessel suspended in the liquid. An addition of sulphate of copper to the ore pulp quickens the operation, but is not essential for its success. The positive pole-plate being dissolved in proportion nearly equivalent to the silver reduced (*i. e.* about 32,108) must, from time to time, be restored. To this end the remaining portion of the plate need not be removed, it being necessary only to cover the spots where the metal has disappeared with patches of copper fastened to the vessel with copper nails.

"The above-described apparatus is also to be employed for the extraction of gold from auriferous pyrites; but if so employed, a positive electrode of iron or carbon (slabs of Bunsen coke or of graphite) is substituted for that of copper. The same change becomes necessary in the treatment of sulphurets and other ores of copper, in which also solid rods of copper in place of tubes are used as negative electrodes. According to the character of the ores, an alkaline sulphate or nitrate, or sulphate of iron, may sometimes advantageously be substituted for chloride of sodium, or used in connection therewith.

For reasons of economy, the employment of galvanic batteries is admissible only in the working of ores of silver; for other ores, magneto-electric machines must be used in their stead, so that, in generating the electric forces required, carbon may be consumed in place of zinc."

APPENDIX.

PRODUCTION OF QUICKSILVER.

The production of quicksilver during the year 1869, was as follow:

Months.	New Almaden.	New Idria.	Redington.*	Other mines.*
	Flasks.	*Flasks.*	*Flasks.*	*Flasks.*
January	1,550	876		
February	1,600	329		
March	2,005	1,148		
April	1,500	1,137		
May	1,400	478		
June	1,203	1,296		
July	1,400	1,155		
August	1,340	650		
September	750	752		
October	950	701		
November	1,000	815		
December	2,200	978		
Total	16,898	10,315	5,500	1,000

* Returns for months not given. Product for the year estimated.

Grand total: 33,713 flasks, at 76½ pounds, or 2,579,044 pounds.

This being a very small production compared with the ordinary demand, the price of quicksilver has in consequence somewhat advanced.

TABLE OF PRODUCTION OF THE PRECIOUS METALS IN AMERICA.

[PREPARED BY C. B. DAHLGREN.]

	Bullion.
All mines of Mexico—discovery to 1868	$5,218,245,000
All mines of Peru, (Cerro Pasco Potosi,)—1545 to 1868	2,800,000,000
All mines of California—1849 to 1869	948,000,000
All mines of Nevada—1859 to 1869	135,000,000
All mines of Montana, Idaho—1862 to 1869	98,000,000
All mines of Colorada, Arizona, New Mexico—1862 to 1869	82,000,000
All mines of Australia, New Zealand—to 1867	184,000,000
	9,455,245,000

RECEIPTS OF TREASURE AT SAN FRANCISCO.

The following tables comprise the receipts of coined and uncoined treasures from the interior and coastwise, through Wells, Fargo & Co. and Pacific Union Express Company, during the years 1867, 1868, and 1869. The Pacific Union Express Company went out of existence on the 1st of December, 1869, the amounts for October and November of that year having been estimated.

FROM THE NORTHERN MINES.

1867.	Uncoined.	Coined.	Total.
ry	$3,077,269	$439,264	$3,516,533
ary	2,262,155	265,857	2,528,012
	2,719,436	281,876	3,001,312
	3,943,605	246,910	4,190,515
	3,521,435	250,354	3,771,789
	3,465,576	273,403	3,738,979
	3,701,611	291,524	3,993,135
st	3,736,035	209,890	3,945,925
mber	3,101,754	185,920	3,287,674
er	3,082,637	307,219	3,389,856
nber	2,968,419	253,263	3,221,682
ber	1,998,695	343,202	2,341,897
otal	37,578,627	3,348,682	40,927,309
1868.			
ry	$2,210,366	$338,441	$2,548,607
ary	2,154,449	405,178	2,559,627
	2,525,708	239,446	2,765,154
	2,981,914	564,432	3,546,346
	3,159,169	239,443	3,398,612
	3,679,819	226,045	3,905,864
	3,526,183	465,382	3,991,565
t	3,446,795	304,183	3,750,978
nber	3,678,520	416,763	4,995,283
er	3,119,847	462,515	3,582,362
ber	2,956,825	417,848	3,374,673
ber	2,989,667	640,957	3,630,624
tal	36,429,262	4,726,633	41,149,895
1869.			
ry	$2,345,975	$660,888	$3,006,863
ary	2,441,174	770,602	3,211,776
	3,085,613	840,920	3,926,533
	2,681,403	628,891	3,310,294
	2,699,892	826,178	3,526,070
	2,755,117	559,982	3,315,099
	2,563,085	539,467	3,102,552
t	2,365,423	649,991	3,015,414
nber	2,456,003	785,096	3,241,099
er	1,847,177	730,115	2,577,292
ber	2,284,910	758,554	3,043,464
ber	2,379,677	700,120	3,079,797
tal	29,905,449	8,450,804	38,356,253

FROM THE SOUTHERN MINES.

1867.	Uncoined.	Coined.	Total.
January	$220,367	$166,707	$387,074
February	203,918	57,452	261,370
March	203,250	98,674	301,924
April	287,478	123,275	410,753
May	290,543	130,600	421,143
June	314,402	114,107	428,509
July	309,661	87,910	397,571
August	262,188	75,825	338,013
September	237,027	104 969	341,996
October	263,728	132,028	395,757
November	254,921	184,837	439,758
December	165,873	187,721	353,594
Total	3,013,356	1,464,105	4,477,461
1868.			
January	$233,284	$162,502	$395,786
February	228,823	139,833	368,656
March	230,392	85,840	316,232
April	236,604	140,216	376,820
May	283,307	125,219	408,526
June	258,018	156,297	414,315
July	253,369	169,725	423,094
August	249,564	117,748	367,312
September	247,279	138,700	385,979
October	235,451	173,089	408,540
November	219,764	206,739	426,503
December	212,926	278,356	491,282
Total	2,888,781	1,894,264	4,783,045
1869.			
January	$175,078	$302,257	$477,335
February	203,349	212,068	415,417
March	274,393	383,363	657,756
April	262,957	275,397	538,354
May	235,109	333,051	568,160
June	246,988	341,909	588,897
July	279,857	312,280	592,137
August	227,075	228,175	455,250
September	192,034	198,796	390,830
October	201,825	266,588	468,413
November	140,737	197,906	338,643
December	128,000	70,000	198,000
Total	2,567,402	3,121,790	5,689,192

COASTWISE.

1867.	Uncoined.	Coined.	Total.
January	$344,440	$15,381	$359,821
February	128,799	10,884	139,683
March	119,398	23,284	142,682
April	344,075	7,450	351,525
May	380,780	11,636	392,416
June	366,265	8,976	375,241
July	760,693	214,744	975,437
August	1,006,186	2,536	1,008,722
September	490,853	5,556	496,409
October	744,349	80,980	825,329
November	536,548	100,520	637,068
December	442,951	45,450	488,401
Total	5,665,337	527,397	6,192,734
1868.			
January	$191,000	....	$191,000
February	194,712	$121,050	315,762
March	193,113	5,529	198,642
April	248,986	99,448	348,434
May	267,892	92,935	360,827
June	400,799	159,350	560,149
July	363,514	101,883	465,397
August	414,610	27,968	443,578
September	385,038	70,599	455,637
October	180,957	56,494	237,451
November	636,774	285,613	922,387
December	477,719	265,032	742,751
Total	3,955,114	1,285,901	5,241,015
1869.			
January	$174,680	$140,660	$315,340
February	96,032	152,933	248,965
March	145,262	208,231	353,493
April	191,243	79,959	271,202
May	191,702	18,050	209,752
June	445,956	105,100	551,056
July	246,237	222,563	468,800
August	115,851	302,895	418,746
September	210,398	109,088	319,486
October	302,084	553,305	855,389
November	350,333	44,637	394,970
December	278,372	555,458	830,830
Total	2,748,150	2,492,879	5,241,029

RECAPITULATION.

	1867.	1868.	1869.
Northern mines	$40,927,309	$41,149,895	$38,356,253
Southern mines	4,477,461	4,783,045	5,689,192
Coastwise	6,192,734	5,241,015	5,241.029
Total	51,597,504	51,173,955	49,286,474

RECEIPTS OF TREASURE, ETC., AT SAN FRANCISCO, CALIFORNIA, FOR THE YEAR 1869.

[Compiled from the San Francisco Commercial Herald.]

The receipts of treasure from all sources (uncoined and coined) through regular public channels, during the past twelve months, as compared with the same period in 1868, have been as follows:

	1868.	1869.
From California, northern mines	$41,149,895	$38,356,253
From California, southern mines	4,783,045	5,689,192
From coastwise ports, Oregon, &c.	5,241,015	5,241,029
Imports, foreign, British Columbia, &c.	3,336,280	6,023,677
Total	54,510,235	55,310,151

INTERIOR RECEIPTS, COINED AND UNCOINED.

	1867.	1868.	1869.
Uncoined	$46.257,320	$43,273,157	$35,221,001
Coined	5,340,184	7,900,798	14,065,473
Total	51,597,504	51,173,955	49,286,474

Interior receipts, imports and exports for the years 1867, 1868, and 1869:

	1867.	1868.	1869.
Interior receipts	$51,597,504	$51,173,955	$49,286,474
Imports, foreign	3,969,322	3,336,289	6,023,677
Total	55,566,826	54,510,235	55,310,151
Exports	41,676,292	35,444,395	37,287.117
Currency movement	13.890,534	19,065,840	18,023,034

The heavy falling off in the receipts of uncoined bullion at this place for 1869, as compared with those of former years, while attributable in part to the diminished production of the mines upon the coast, is mainly due to other causes, chief among which is the very considerable shipments of bullion made directly East by railroad from Eastern Nevada, Idaho, Utah, and Montana, and which, before the completion of that thoroughfare, was sent to this place. Latterly, and since the White Pine mines have become more largely productive, about one-half their proceeds have taken that direction, much of it having been transmitted in the first instance to various points to suit the convenience of parties residing in different parts of the country, being large owners in those mines. These shipments have been going on throughout the year; slightly at first, but more fully and with constant acceleration since the opening of the railroad. What little bullion has been produced in Utah has, also, no doubt, mostly gone in that direction. The diversion east of the product of the Idaho mines has not been large; being perhaps a million more than formerly went that way; while it is fair to presume that almost the entire yield of Montana for the past year has been turned into eastern channels. During the year a good deal of silver has arrived in San Francisco in the lead bars sent from the various smelting districts, none of which has been included in the figures representing the gross yearly receipts of this place. The value of the precious metals coming here in this shape would probably aggregate half a million of dollars. After giving these causes due credit for their agency in diminishing our last annual receipt of bullion, there remains a balance of deficit which can only be accounted for by an admitted decline in the product of our mines; and in evidence of which we have the fact of a slight falling off in the returns from Nevada, and the probabilities of a similar result in Oregon, Idaho, and Montana, the California product varying but little perhaps from that of the preceding year.

In view of the foregoing facts it will be seen that the diminished bullion yield of the coast, as reported for the past year, is more apparent than real; suggesting the probability that the mining interest during this period has been fairly prosperous.

MINT STATISTICS.

The coinage at the branch mint for the year 1869 compares with that in 1866, 1867, and 1868, as follows:

	1866.	1867.	1868.	1869.
January	$315,000	$124,000	$97,000	$467,000
February	910,500	1,022,000	640,000	185,000
March	1,360,000	978,535	575,000	743,000
April	1,113,000	1,895,000	710,000	1,579,000
May	2,165,000	2,505,000	714,000	985,000
June	1,120,000	1,420,000	922,000	1,348,000
July	1,004,000	1,152,000	2,355,000	1,040,000
August	1,758,000	2,380,000	1,465,000	689,500
September	1,916,000	1,989,000	2,465,000	2,550,000
October	2,312,000	2,361,000	2,415,000	1,669,300
November	2,214,000	2,260,000	2,595,000	1,648,000
December	1,719,000	1,284,000	2,422,000	1,459,750
Total	17,915,500	19,370,535	17,365,000	14,363,550

The operations of the branch mint have been restricted by reason of diminished deposits, arising from correspondingly diminished receipts of bullion and dust from interior points. The coinage for 1869 falls short of that for 1868 by $3,000,000, and that of 1867 by $5,000,000. This deficit is by no means owing to the decreased capacity of our mines, but is more directly the result of a large emigration to those of White Pine and other districts, and to the increased attention paid to farming, which has engaged many hands formerly employed in getting out the precious metals. The sad calamity which ravaged three of the most productive mines on the Comstock lode also contributed to a materially diminished supply of bullion; besides which the mint was idle during a portion of July to prepare for turning it over to the new appointees. There is good ground for the belief that the bullion supply for 1870 will very considerably exceed that for the past year.

Estimated production of gold and silver in the United States from 1849 *to* 1868, *both inclusive.*

[By E. B. ELLIOTT, Esq., Treasury Department, Washington.]

Years.	Aggregate.			Annual average.		
	Gold.	Silver.	Gold and silver.	Gold.	Silver.	Gold and silver.
	Millions.	*Millions.*	*Millions.*	*Millions.*	*Millions.*	*Millions.*
1849–'51, (3 years)	$94. 0	....	$94. 0	$31. 3	....	$31. 3
1852–'56, (5 years)	350. 8	....	350. 8	70. 2	....	70. 2
1857–'58, (2 years)	131. 9	....	131. 9	65. 9	....	65. 9
1859–'63, (5 years)	268. 3	$18. 3	286. 6	53. 7	$3. 6	57. 3
1864–'68, (5 years)	207. 4	69. 3	276. 7	41. 5	13. 8	55. 3
1849–'58, (10 years)	576. 7	....	576. 7	57. 7	....	57. 7
1859–'68, (10 years)	475. 7	87. 6	563. 3	47. 6	8. 7	56. 3
1848–'68, (20 years)	1, 052. 4	87. 6	1, 140. 0	52. 6	4. 4	57. 0

The above may be read as follows: During the five years, 1864–'68, the *aggregate* production of gold was approximately $207,400,000; of silver, $69,300,000; the total for both (gold and silver) being $276,700,000. In the same period the *annual average* production of gold was approximately $41,500,000; of silver, $13,800,000; the total for both (gold and silver) being $55,300,000.

Table showing the value of total imports, exports, and re-exports of specie and bullion during the ten years, 1860–'69.

By E. B. ELLIOTT, Esq.]

During fiscal year ended June 30.	Imports into the United States.	Exports from the United States.	Re-exports from the United States.
1860	$8, 550, 135	$56, 946, 851	$9, 599, 388
1861	46, 339, 611	23, 799, 871	5, 991, 210
1862	16, 415, 052	31, 044, 651	5, 842, 305
1863	9, 584, 105	55, 993, 562	8, 163, 049
1864	13, 115, 612	100, 321, 371	4, 922, 979
1865	9, 810, 072	64, 618, 124	3, 025, 102
1866	10, 700, 092	82, 643, 374	3, 400, 697
1867	22, 070, 475	54, 976, 196	5, 892, 176
1868	14, 188, 368	83, 746, 161	10, 038, 127
1869	19, 807, 876	42, 915, 966	14, 222, 414
Total	170, 581, 398	597, 006, 127	71, 097, 447

Table of the state of the lawful money reserve (required by sections 31 *and* 32 *of the national currency act) of the National Banking Associations, as shown by their reports of various dates during the year ended June* 30, 1869. *From the Annual Reports of the Comptroller of the Currency for the years* 1868 *and* 1869.

[By E. B. Elliott, Esq.]

Dates.	Amount required as reserve.	Items of reserve.				Amount of available reserves.
		Legal tenders.	Specie.	Three p. cent. temporary loan certificates.*	Amount due from approved associations in the redemption cities, available for the redemption of circulating notes.	
July, 1868	$186, 421, 682	$100, 166, 100	$20, 755, 921	$64, 378, 220	$75, 834, 359	$261, 134, 600
October, 1868	172, 259, 139	92, 453, 475	11, 749, 444	63, 593, 730	66, 965, 278	234, 761, 927
January 4, 1869	167, 996, 991	88, 239, 300	27, 537, 637	52, 075, 000	65, 727, 064	233, 579, 001
April 17, 1869	159, 193, 947	80, 875, 161	8, 474, 703	51, 190, 000	57, 547, 694	198, 087, 558
June 12, 1869	165, 622, 593	80, 934, 119	17, 480, 076	49, 815, 000	62, 912, 635	211, 141, 830
Average	168, 298, 870	88, 533, 631	17, 199, 556	56, 210, 390	65, 797, 406	227, 740, 983

* The returns under this head for July and October, 1868, include some compound interest notes.

Estimates by different writers of the production of gold and silver in the world since 1848.

[By E. B. Elliott, Esq.]

Authorities.	Gold.	Silver.	Gold and silver.
	Millions.	*Millions.*	*Millions.*
Mr. Newmarch, (1849–'68,) twenty years, old sources	$1, 428. 4	$1, 514. 1	$2, 942. 5
new sources	1, 777. 7	182. 5	1, 960. 2
all sources	3, 206. 1	1, 696. 6	4, 902. 7
Dr. Soetbeer, (1849–'67,) nineteen years, all sources	$2, 535. 8	$982. 4	$3, 518. 2
Prof. Blake, (1849–'67,) nineteen years, all sources	2, 757. 6	813. 4	3, 571. 0
Mr. J. S. Wilson, (1849–'67,) nineteen years, all sources	2, 495. 1	971. 0	3, 466. 1

In the above table the values are given in millions of dollars, so that, for example, 1,428.4 denotes $1,428,400,000.

Estimates of the production of precious metals in the United States during the nineteen years, 1849 *to* 1867, *both inclusive.*

Authorities.	Gold.	Silver.	Gold and silver.
	Millions.	*Millions.*	*Millions.*
Professor W. P. Blake	$1, 000. 0	$73. 0	$1, 073. 0
Mr. Joseph S. Wilson	1, 015. 0	100. 0	1, 115. 0
Mr. J. Ross Browne			1, 255. 0

Adding to the mean of these figures my estimates for 1868 and 1869, we have a probable production of gold and silver, from 1849 to 1869, inclusive, of 1,278 million dollars, or an average of a little less than sixty-one millions per annum. The production of 1869 was not far from this average. R. W. R.

FINENESS OF QUARTZ AND PLACER GOLD IN NEVADA COUNTY, CALIFORNIA.

After sending the sheets of this report to press, I became possessed of the following interesting and valuable table of the fineness of quartz and placer gold at numerous localities in Nevada County, California. It was prepared in 1867 for the report of Mr. J. Ross Browne, by Mr. J. S. Hittell, of San Francisco, and excluded from that report for want of space. A comparison of the localities on the same water-courses, and of the gold of the placers with that of the lodes which were probably their original sources, would interestingly illustrate some of the views which I have expressed in Part III of the foregoing report. But I must forego such a discussion of these observations here, and content myself with putting them on record:

FINENESS OF NEVADA PLACER GOLD.

[The figures opposite each locality show the fineness of the gold in thousandths.]

Alpha	917–968	Gold Flat	815–830
American Hill	905	Greenhorn	865–870
Arkansas Cañon, (near Red Dog)	936	Green Mountain	916
Brush Creek	958–961	Gold Flat Ravine	837
Bourbon Hill	837–844	Hunt's Hill	913–930
Brandy Flat	870	Humbug	920–953
Buckeye Hill	877	Hitchcock Ravine	825
Brown's Hill	906	Hog Ravine, (near Red Dog)	962
Booyer's Ranch	874	Jefferson Flat	874
Blue Flat	885–925	Jefferson Hill	911
Bourbon Hill	841	Jackass Flat	879
Birchville	942	Jones's Bar, (South Yuba)	874–878
Beckville	848	Kentucky Flat	870
Big Deer Creek	845–850	Kanaka Creek	975–980
Christmas Hill	945	Kansas Hill	836
Cement Hill	840–852	Little York, (blue gravel)	892–910
Chalk Bluff	960–976	Little York, (red gravel)	960
Columbia Hill	922–961	Lost Hill	885–890
Crumbeck Ravine	866	Liberty Hill	896–908
Cherokee	910–920	Lawson Flat	877
Coyote	850–860	Lowell Hill	904
Coolie Hill	964	Lost Ravine	870–903
Colton Hill, (upper strata)	964	Long Hollow	834
Colton Hill, (bed rock strata)	890	Little Deer Creek	790–795
Christmas Hill, (Bay State claim)	980	Manzanita Hill	822–830
Cedar Ravine	865	Mud Flat	818
Canada Hill	545	Mosquito Creek	790–800
Deer Creek	890–906	Montezuma Hill	865
Diamond Creek	949–955	Miles's Ravine	860
Eureka	831–853	Mount Oro	872
Eureka, (other claims)	825–835	Myers Ravine	860–870
Eagle Ravine	848	Missouri Bar, (on the South Yuba)	883
Fall Creek	880	Middle Yuba	880
French Garden	820	Newtown	825
French Corral	840	Native American Ravine	884
Fall Creek	878	North Wolf Creek	829
Gold Hill	965–970	Nary Red	916
Gopher Hill	884–936	North Yuba	890
Grizzly Cañon	810	Omega	950–955

s Flat	895–910
n Hill	875–890
ne Hill	841
nt Valley	898–904
lat	828
an's Creek	860–880
s Hill, (near Gold Hill)	913–920
Ravine	828–833
ne Point	850–890
r Hill, (blue gravel)	922
r Hill, (red gravel)	960
and Ready	875–880
snake	810
Mountain	834–879
reek	840–879
gton Hill	920
Hill	931
reek	870
og	903–930
reek	791–810
lph Flat	920
man's Creek	897–922
Creek	900–910
an, north	960
Flat	922–940
Hill	840–865
Selby Flat	840–845
Sweetland	900–930
Snow Point	880–885
Sailors' Flat	870–875
Steep Hollow	900–903
South Yuba	870–875
Slate Creek	814
Timbuctoo	940–950
Thomas's Flat	854
Virgin Flat	886
Wolf Creek	800
Washington	870
Wood's Ravine	845
Woolsey's Flat	910
Washington	870–886
Walloupa	888–910
Walloupa Ravine	852
Woolf's Creek, (n'r Grass Valley)	845–855
Woolf's Creek, (elsewhere)	910
Wolf Creek, (at Kansas Hill)	820–845
Wet Hill	855–875
Wilcox Ravine, (near Red Dog)	944
You Bet, (blue gravel)	890–919
You Bet, (red gravel)	907–984
You Bet claim	994
Yankee Hill	917

FINENESS OF NEVADA QUARTZ GOLD.

n Ranch	850–860
iver	803
ranklin	808
ridge	820
a Hill	730
nd	846–856
o	800
a	852
Spring	810
n Ridge	819
ill	850–875
ear	840
s	854
	815
n Mine	813–830
	827
	817
nac	817
y	800
Nevada	830–859
New York Hill	850–860
North Star	852
Osborne Hill	760–775
Pacific	845
Potosi	816–818
Rattlesnake	800
Rocky Bar	853
Shamrock	799
Shanghae	860
Sneath & Clay	823
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Union Jack	811–823
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